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AN ACCOUNT

OF

BRITISH FLIES

(*DIPTERA*).

BY

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CAMBRIDGE UNIVERSITY EXTENSION LECTURER IN INJURIOUS INSECTS, ETC.

VOL. I.

540079
2.5.52



LONDON:

ELLIOT STOCK, 62, PATERNOSTER ROW, E.C.

1892.



P R E F A C E .

THE reason I undertook to publish this book was the almost total absence of any treatise in English upon this much-neglected order of insects. I have dealt with most of the species indigenous to the British Isles, and with many points of general interest relating to the order of "Flies," also with the characteristics of families and genera, and, where possible, with the life histories of the various groups, especially of those that are injurious to our crops and farm stock.

The only English work published on this subject is Walker's "Insecta Britannica Diptera," which is now out of print. It was written more than fifty years ago, and naturally contains much that is quite out of date and inconsistent with the knowledge of the present day.

It is hoped that this account may in some way fill up this gap in entomological literature. The author trusts he will be pardoned for the many discrepancies that may have crept in, owing in many instances to his imperfect knowledge of the languages in which most of the literature on this subject is written. For those who wish to go more fully into the subject, the larger works of Meigen ("Zwei-flugelige Insecten"), Macquart ("Diptères exotique"), and Schiner ("Fauna Austriaca"), together with the numerous papers, articles, and pamphlets enumerated at the end of each family, may be consulted.

In a small work of this kind it is impossible to give a detailed description of all the species recorded as British. I have therefore chosen those about which there seems no doubt, and have omitted many mentioned by Walker as being doubtful. The

families treated of in this volume are the most difficult and least understood of any, and are in a most unsatisfactory state with regard to their systematic arrangement and identification. It is hoped that this account may spur younger workers on to establish new and important facts, so that inaccuracies may be corrected which naturally will be found in it, and new discoveries made.

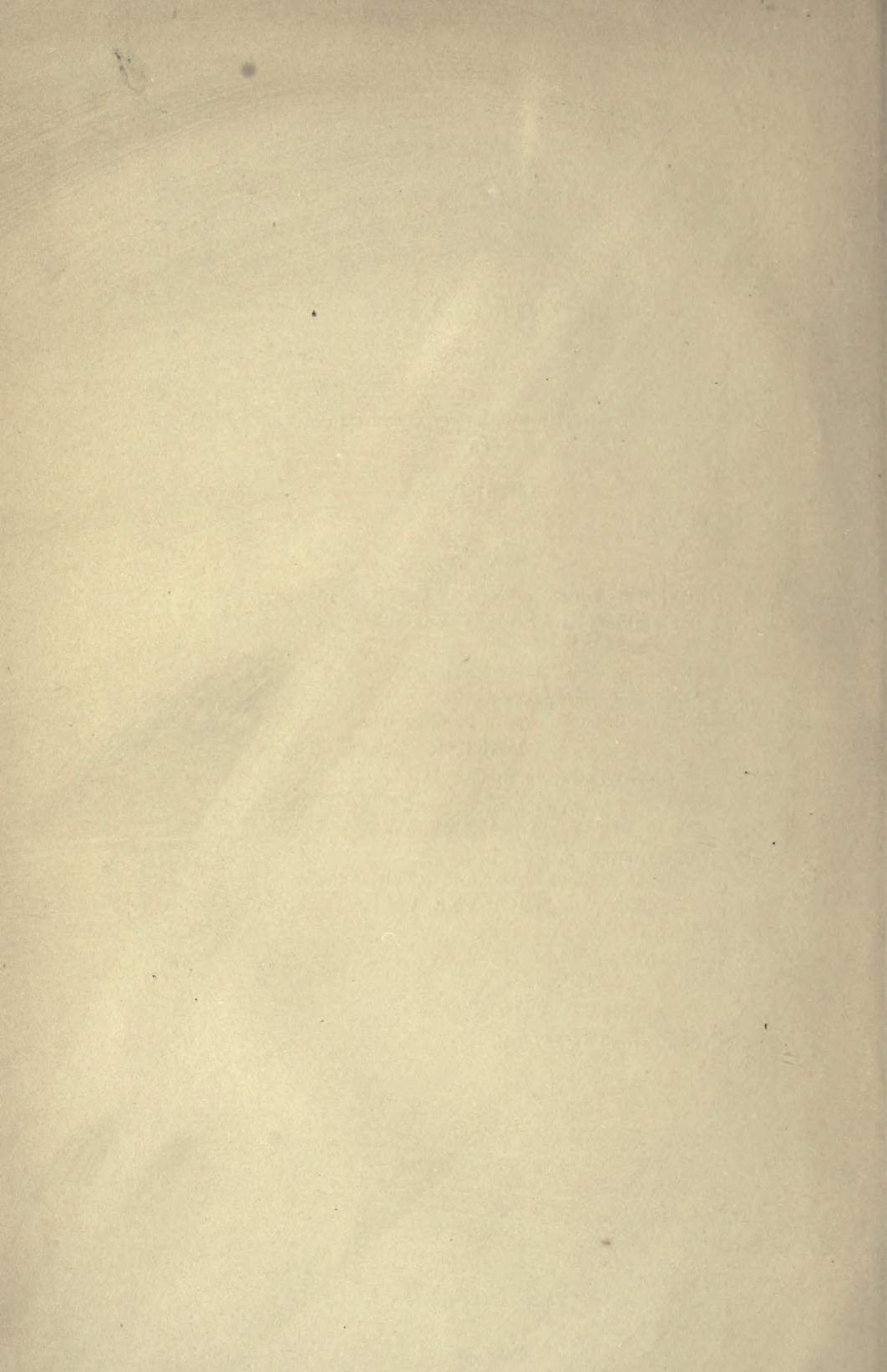
I have to express my thanks to numerous entomologists for kindly help, and for lending specimens to be figured, especially to Miss Ormerod for the loan of blocks from her "Manual of Injurious Insects."

FRED. V. THEOBALD.

CAMBRIDGE, 1892.

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A SHORT ACCOUNT OF THE MORE IMPORTANT CHARACTERISTICS OF THE FAMILIES OF DIPTERA.

Family *Pulicidæ*.

Parasitic insects, with scale-like rudimentary wings; long legs, very large coxae, tibiae spurred. Eyes may or may not be present. Thorax composed of three distinct segments.

Family *Cecidomyidæ*.

Ocelli often absent. Thorax with no transverse suture. Antennæ moniliform, 24-jointed in ♂, 12 to 14 in the ♀. Wings with only few nervures. Coxæ not elongated, femora not thickened, no spurs on tibiae.

Family *Mycetophilidæ*.

Ocelli two or three; often so small they can only just be discernible. Thorax with transverse suture. Antennæ usually 16-jointed. Eyes generally round. Few nervures in wings, no discal cell. Tibiae spurred, coxae elongate.

Family *Bibionidæ*.

Ocelli three. Thorax without transverse suture, pro-thorax largely developed. Eyes of ♂ large and contiguous, small in ♀. Antennæ 9-jointed. No discal cell in wings. Feet armed with long empodium, pulvilli present in some genera.

Family *Simulidæ*.

Ocelli none. Thorax without transverse suture. Posterior tibiae and first joint of hind tarsi dilated. Antennæ cylindrical, 11-jointed.

Family *Chironomidæ*.

Head small, retracted; often partly covered by thorax. Ocelli none. No transverse suture on thorax. Eyes reniform. Antennæ from 6 to 15 joints; pectinate in ♂, simple and composed of fewer joints in ♀. Wings without vein along the posterior margin; costal vein ending near the tip of the wing.

Family *Orphnephilidæ*.

Ocelli absent. Head small, round; eyes round. Costal vein continued round the posterior border of wing.

Family *Psychodidæ*.

Ocelli absent. Body with long, coarse hairs. No transverse suture to thorax. Antennæ long, 16-jointed. Wings very broad and hairy; many longitudinal veins, only a few transverse veins; no discoidal cells. Legs long, tibiae without spurs.

Family *Culicidæ*.

Ocelli none. Thorax with no transverse suture. Head small. Antennæ long, 15-jointed; pectinate in ♂. Costal vein continued round margin of wing, fringed with scales; veins in their last subdivisions more than six in number.

Family *Dixidæ*.

Ocelli wanting. Head rounded. Antennæ long, 12-jointed; basal joint thick, flagellum slender.

Family *Tipulidæ*.

No ocelli. Thorax with V-shaped transverse suture. Antennæ long, composed of 6 to 19 joints. Basal cells of wings reaching beyond the middle. Discal cell generally present. Legs long and slender.

Family *Rhyphidæ*.

Ocelli three. No transverse suture on thorax. Antennæ as long as thorax; 16-jointed. Wings with a perfect discal cell, large and broad. Empodium like a pulvillus, pulvilli wanting.

Family *Stratiomyidæ*.

Head short, as broad as thorax. Third joint of antennæ annulated; furnished with a terminal bristle. Ocelli present. Three basal cells, much prolonged. Veins of two main trunks very crowded anteriorly. Costal vein reaching only to middle of wing. Tibiæ spurless. Empodium large, resembling pulvillus.

Family *Xylophagidæ*.

Head short and broad. Third joint of antennæ annulated; no terminal bristle. Three basal cells, very prolonged. Third longitudinal vein furcate; both intercalary veins present. Marginal vein encompassing the whole wing. Tibiæ with spurs. Empodium as above.

Family *Tabanidæ*.

Three basal cells, very prolonged. Third longitudinal vein furcate. Two intercalary veins always present; marginal running around whole border. Tegulæ large. Head broader than thorax. Third joint of antennæ annulate, generally entire; no terminal bristle. Proboscis strong and prominent. Empodium large, pulvilliform.

Family *Leptidæ*.

Head smaller than in *Tabanidæ*. Antennæ short, last joint rounded, furnished with terminal bristle.

Family *Asilidæ*.

Three basal cells, much prolonged. Third longitudinal vein furcate, and the two intercalary veins present. Head short and broad; eyes prominent. Third joint of antennæ simple. Thorax narrowed in front. Empodium like a horny bristle.

Family *Bombylidæ*.

Three basal cells much prolonged; the anterior intercalary present, the posterior always wanting. Proboscis prominent, long and slender. Third joint of antennæ simple, generally provided with a bristle or tuft at the end. Empodium rudimentary.

Family *Therevidæ*.

Three basal cells prolonged; both intercalary veins present. Third longitudinal vein furcate. Antennæ with short terminal bristle. No empodium.

Family *Scenopinidæ*.

Three basal cells, very large; the third closed far from the border of wing. No intercalary vein; third longitudinal vein furcate. Antennæ with third joint very long, no terminal bristle. No empodium.

Family *Cyrtidæ*.

Eyes very large. Tegulæ vaulted, very large. Basal cells long. Neuration very variable, often incomplete. Terminal antennal joint simple. Tibiæ spurless. Empodium large, pulvilliform.

Family *Empidæ*.

Three basal cells complete, large; the third shorter than second. Posterior basal transverse vein parallel to border of wing. Anterior intercalary present, posterior wanting. Antennæ with first two joints very small, hardly distinct; third not annulated; often with a terminal bristle. Empodium membranaceous.

Family *Dolichopodidae*.

First basal cell rather short, the second united with discal cell, third small. Auxiliary vein running in the first longitudinal. Third vein simple; fourth often furcate. No intercalary vein. Empodium small, membranous. Antennæ close together; third joint not annulated, with bristle at tip.

Family *Lonchopteridae*.

Three basal cells of moderate size, nearly equal in length. Fourth longitudinal vein furcate, and united with fifth near the base. First two joints of antennæ small, testaceous; third rounded, with a slender apical bristle. Empodium wanting.

Family *Platypezidae*.

Three basal cells rather large, the hindmost always ending acutely at more or less distance from the border of the wing. Third longitudinal vein simple. No intercalary vein. Antennæ with apical bristle. Empodium wanting.

Family *Pipunculidae*.

Three basal cells much prolonged, the hindmost closed near the border of the wing. Fourth vein may be absent, furcate when present. No intercalary vein. Eyes large, not quite contiguous in ♂. Antennæ short, with a basal bristle. Legs with few short spines. Empodium wanting.

Family *Syrphidae*.

Three basal cells much prolonged. Third longitudinal vein simple; a spurious longitudinal vein between third and fourth; fourth united at its end to the third; no intercalary veins. Antennæ close together; third joint various, generally compressed and with a bristle on its back. Hypopygium unsymmetrical. No empodium. Head semicircular, as broad as thorax.

Family *Conopidae*.

Three basal cells, large, third closed, more or less remote from the posterior border. All the longitudinal veins simple; no intercalary vein. Head large, always broader than thorax. Antennæ long; third joint clubbed and ending in a bristle. Hypopygium symmetrical. Empodium wanting. Proboscis generally prolonged. Eyes not contiguous.

Family *Œstridae*.

Antennæ inserted in round pits. Oral organs rudimentary. Tegulæ large. Antennæ short; third joint with a terminal bristle. Very hairy flies, resembling bees.

Family *Tachinidae*.

Antennal bristle bare, or covered with minute pubescence. Thorax short. First posterior cell closed, or only faintly open. Abdomen more or less oval, beset with bristles. Legs short.

Family *Dexidae*.

Antennal bristle hairy or pectinated. Thorax short. First posterior cell as above. Tegulae large. Abdomen with long bristles on at least the last two segments. Legs long.

Family *Sarcophagidae*.

Antennal bristle plumose or hairy; apex bare. First posterior cell as above. Tegulae large. Legs stout.

Family *Muscidae*.

Antennal bristle entirely plumose or pectinated. Body stout, thorax short. First posterior cell only slightly opened or else closed at the border of the wing.

Family *Anthomyidae*.

Antennal bristle naked or pectinated. Thorax with a complete transverse suture. First posterior cell fully open. Tegulae not very large. Abdominal bristles often absent.

Family *Cordyluridae*.

Neuration complete. Both posterior basal cells large. Auxiliary separated from the first longitudinal vein. Whole lateral border of the front bristly; anterior border of mouth with numerous strong vibrissae.

Family *Phycodromidae*.

Front bristly; border of the mouth hairy, with no distinct vibrissae. Legs stout; tibiae with spurs, and each with a small bristle on the outside, near the tip; the first joint of posterior tarsi not abbreviated; last joint of all the tarsi enlarged, with stout claws and long pulvilli. Costa without bristles; basal cells not small.

Family *Helomyzidae*.

Front bristly on its upper half only. A stout bristle at each side on the anterior border of mouth. Costa bristly. First longitudinal vein not abbreviated, but bare. All the tibiae with spurs, and with a more or less developed erect bristle on the outside near the tip.

Family *Psilidae*.

Body elongate, with short hairs and almost without bristles. Front with only a few bristles in the neighbourhood of the crown, no bristles near mouth. Neuration complete; auxiliary vein lies close by the first longitudinal vein, but diverges from it at its end and runs towards the border of the wing; by a transverse fold, most characteristic in this family, running from tip of auxiliary vein as far as the base of the third posterior cell, the outward end of the auxiliary vein is obliterated. Posterior basal cells large.

Family *Micropezidae*.

Body slender, with short hairs and very few bristles. Neuration of veins complete; first longitudinal vein bare; auxiliary vein is very close by it, and diverges from it towards its end only; the two posterior basal cells very large. A few bristles on the crown only; no vibrissæ on the mouth-border. No bristle on outer side of tibiæ.

Family *Ortalidae*.

Auxiliary vein separated from the first longitudinal and running to border of wing in the usual way under an acute angle and remaining perfectly distinct in its whole length; third longitudinal vein generally with coarse hairs. Two posterior basal cells large, the outward one frequently prolonged in an acute angle. Front with bristles on the upper part only. No vibrissæ at the border of the mouth. Clypeus very much developed. Middle tibiæ alone with spurs; no bristle on tibiæ. Ovipositor of ♀ flattened and horny, composed of three elongated segments and ending in a simple point.

Family *Trypetidae*.

End of auxiliary veins runs steeply to the border of the wing and becomes obsolete; first longitudinal vein always with bristles, the third frequently, the fifth sometimes; the hindermost posterior cell produced to a point. Front on each side with two rows of bristles, one above and placed interiorly, and one below. No vibrissæ on border of mouth. Clypeus none or rudimentary. Middle tibiæ only with spurs; no bristle present on tibiæ. Ovipositor horny, as in preceding family.

Family *Lonchæidae*.

Auxiliary vein runs to border of the wing in the usual way under an acute angle and without becoming obsolete and near to the first longitudinal vein; this vein is bare. Two posterior basal cells small. Front at each side with a single row of bristles. No vibrissæ.

Clypeus rudimentary. Middle tibiæ with spurs. Ovipositor consists of three joints and is horny and flat.

Family *Sapromyzidæ*.

Auxiliary vein as in the preceding, frequently very much approximated to the first longitudinal vein. Costa without bristles or marginal spine. Posterior basal cells small. No peculiar hairs on the longitudinal veins. Front with a single row of bristles on each side. Only the middle tibiæ have terminal spurs; all have the small erect bristles. Ovipositor not horny.

Family *Heteroneuridæ*.

First longitudinal vein short, auxiliary very much approximated to it. No bristles on costa. Basal cells small. Front with long bristles. A vibrissa on the border of the mouth at each side. Palpi large. Legs slender. Middle and posterior tarsi with spurs.

Family *Opomyzidæ*.

First longitudinal vein much abbreviated; the auxiliary becomes obsolete before reaching completely the first longitudinal vein; the latter sends out before its end, towards the costa, a branch, which may be considered as the end of the auxiliary vein. Basal cells small. Axillary incision and alulæ wanting. Front with stout bristles above border of mouth pubescent and with long hairs. Palpi small.

Family *Sepsidæ*.

Auxiliary vein distinctly separated from the first longitudinal veins. Posterior basal cells large. Head rounded. Front bristly. Border of mouth more or less hairy, the foremost hair often imitating a vibrissa.

Family *Piophilidæ*.

Front with some small bristles above only. A vibrissa on each side of the border of the mouth. Abdomen often petiolate and curved. Auxiliary vein coalescent with the first longitudinal vein along its whole length.

Family *Geomyzidæ*.

Front with stout bristles above. Border of the mouth with vibrissæ. Bristles along costa. First longitudinal very short, the auxiliary separated from it only near base. Posterior basal cells very small. All the tibiæ having an erect hair on the outer side before the tip.

Family *Ephydriidae*.

Face very convex, covered with hairs and bristles, but no vibrissæ. Clypeus large. Proboscis incrassated with a swollen chin. Neuration incomplete. Auxiliary vein distinct only at its base. Anterior basal cell united to discal cell.

Family *Drosophilidae*.

No bristles along costa. First longitudinal vein very much curtailed; auxiliary rudimentary. Front bristly above. Small vibrissa at border of mouth. A distinct sub-antennal furrow. Antennæ with third joint long, terminal bristle pectinate or pubescent.

Family *Chloropidae*.

No bristles along costa. No auxiliary vein. Anterior small basal cell united to discal, the posterior one wanting. Bristles only on the crown. Border of mouth with no vibrissæ, but sometimes a single hair.

Family *Agromyzidae*.

No costal bristles. First longitudinal vein short, the auxiliary connected with it at tip; posterior transverse vein far distant from the border. Front with strong bristles. Border of mouth with vibrissa on each side. Third joint of antennæ rounded, terminal bristle bare or pubescent.

Family *Phytomyzidae*.

No bristles along costa. Veining much as in above, but no posterior transverse vein.

Family *Astiidae*.

No bristle along costa. First and second longitudinal vein short. The two posterior basal cells, as well as the transverse vein, wanting.

Family *Borboridae*.

Neuration incomplete, only the commencement of the auxiliary vein being seen. Thorax, scutellum, and abdomen flat. Front bristly. Face excavated, with a vibrissa on each side of border of mouth.

Family *Phoridae*.

Wings with several stout veins running along the costa, and three or four weak ones which run across surface of wings and not completely connected with hindmost of the stout veins from which they seem to issue. Antennæ apparently only single-jointed, with long bristle.

Family *Hippoboscidae*.

Body horny and flattened. Head flattened. Antennæ composed of one joint only, and furnished with terminal bristle. First joint of all, or, at least, of the anterior and middle tarsi, abbreviated.

Family *Braulidae*.

Wingless and blind ; parasitic on hive bee.

Family *Nycteribidae*.

Antennæ short, 2-jointed. Head not flattened. First joint of all the tarsi long, or very long in comparison with the following. Eyes present. Spider-like.

E R R A T A.

Page 12, line 28, for "Centis" read "Curtis."
Page 15, insert "Anisomerinæ" in Fam. II.
Page 16, Fam. 31, for "Desidæ" read "Dexidæ."
Page 16, insert "Fam. Leptidæ" after "Tabanidæ."
Page 23, line 8, also pages 25 and 32, for "pupiate" read "pupate."
Page 31, *Sarcopsyllus gallinaceus* belongs to a perfectly distinct genus to *P. gallinae*.
Page 32, line 12, for "Antennæ" read "Palpi."
Page 35, line 20, for "Palicide" read "Pulicidæ."
Page 39, fig. 6, for "Catacha" read "Catocha."
Page 78, line 1, for "ingulbine" read "inquiline."
Page 86, line 27, for "Rud" read "Rnd."
Page 93, line 13, for "States" read "Slates."
Page 96, line 13, for "larvae" read "larva."
Page 172, line 23, and page 173, for "Grumm" read "Grimm"

AN ACCOUNT OF BRITISH FLIES (DIPTERA).

CHAPTER I.

FOSSIL DIPTERA.

ONE of the branches of science that has advanced with rapid strides during recent years is geology; in all quarters of the globe fresh discoveries have been made, which have entirely altered many of the old theories and beliefs. We have here only to deal with one branch of geology, namely *Palæontology*, or the study of fossil animals and plants.

At the end of the last century William Smith, a land surveyor, laid the foundation of *Palæontology*. He showed that strata could be traced and identified by their included fossil animal remains, and in 1815 he published his work on "Strata Identified by their Organic Fossils," and thus laid the foundation of a new branch of geology that was destined to take the place of mineralogy as the handmaid of geology.

From this time onwards continual advances have been made in palæontological study, in all parts of Europe and America. England has been especially to the fore in this respect. It is, however, comparatively recently that insects have attracted the attention of fossil collectors.

We owe our knowledge chiefly to Scudder, Brodie, Heer, Loew, etc. Scudder has published a good account in the American Government Reports. Brodie had, however, previously written on the Mesozoic and Tertiary insects, and had figured a good many specimens.

Prior to giving an account of the fossil Diptera it seems well to append a short description of the order.

Order DIPTERA.

Mouth suctorial, and used for piercing, the labium being greatly developed and forming a gutter for the reception of the lancets (maxillæ and mandibles).

This proboscis, which is chiefly made up of the labium, ends in a fleshy swollen tongue, and is without palps. It is closed above by the labrum.

The maxillæ are provided with palps; the mouth, however, may be obsolete or closed.

The head is usually large and spherical, and is attached to the thorax by a short neck. Two large facetted eyes are present, and there may be ocelli as well. In the ♂ the eyes may join in the middle line, this being a valuable way to distinguish sex.

The antennæ are of two forms, (α) long and filiform, and composed of many joints; or (β) short, with the third joint inflated, and bearing two or three tapering joints or a bristle.

The thorax is usually large and compact; the prothorax very much reduced, and attached as a collar to the mesothorax, which is very large and is developed at the expense of the other two regions of the thorax.

One pair of true wings only developed, these being the anterior ones, and are usually transparent and never folded, with an inferior basal lobe. Veins crowded in front, distant behind. Cross veins few.

The hind wings reduced to small club-shaped laminae, known as *halteres*. Both may be absent. The abdomen generally small, but may be elongated, as in the *Tipulidæ*, and composed of five to nine segments.

Legs six in number, and slender, having five jointed tarsuses, ending in unguis or "pads" for attachment. The nervous system presents various modifications—in some the ganglia of the thorax and abdomen become fused, or there may be three thoracic ganglia and five or six abdominal ganglia. The male genital organs consist of two testes with vasa deferentia and copulatory appendages.

The female have three receptacula seminis in connection with the vagina, and in some cases have a retractile ovipositor.

Having given a short general description of the Diptera we can now pass on to the review of the fossil species. In dealing with the ancestral forms of our flies, we include those found in all parts of the world, as very few have been discovered in England, compared

with the number that have been found on the Continent and in America.

One of the chief modes of preservation is in amber, the greater number of species having been found in this state. The earliest recorded occurrence of Diptera is in the Mesozoic period, although insects appeared in the early Palaeozoic period. The extreme fragility of insects renders their preservation difficult, and we therefore find but a very scanty representation of the Dipterous fauna. It will be only possible here to give a short account of the genera, many of which are described only from such fragmentary remains as wings and other detached portions.

α.—BRACHYCERA.

Fam. *Dolichopodidae*.—The members of this family are very abundant in the fossil state, being beautifully preserved in amber. Particular attention has been paid to these by Loew, who has enumerated nearly seventy species of *Dolichopus*, *Rhaphium*, *Poilopus*, *Medeterus*, and *Chrysotus*. The genus *Dolichopus* has also been described from Wyoming.

Fam. *Empidæ*.—This family has been figured by Brodie from the Wealden of England ; and, according to Giebel, the species described belongs to a new genus—*Hasmona*.

Loew has described the genus *Empis* from the Rhenish coal and sixteen from amber. Giebel, Heer, and Loew have described many other genera besides these from the amber of the Tertiaries.

Fam. *Bombylidæ*.—Alone found in the Tertiaries, the genus *Anthrax* being found at Oeningen and on the Rhine. They are mostly found in amber.

Fam. *Asilidæ*.—Brodie describes an *Asilus* from the Lower Lias, and Germar another (*Asilicus*) from the oolite of Solenhofen. These are the only two recorded Mesozoic species. In amber the Asilidæ are more abundant. Many are described from Oeningen and in Sicilian amber.

Fam. *Leptidæ*.—This family is rare in a fossil state. One species has been recognised in the Eocene of the Isle of Wight.

Fam. *Tabanidæ*.—The Swiss geologist, Heer, describes and figures one of this family from Oeningen, and it is also reported from the Rhenish coal.

Fam. *Stratiomyidæ*.—Both perfect insects and larvæ have been found in the Tertiary and Quaternary deposits. They have mostly come from Aix, where Serres recognised *Oxycera* and *Sargus*.

Oustalet also describes a species of *Stratiomys* from Pontary in the Miocene deposits.

β.—NEMATOCERA.

Fam. *Rhyphidae*.—Brodie has figured a species of this family from the English Purbecks under the name of *Rhiphus priscus*.

It is more abundant in the Tertiaries, and is described by Heer.

Fam. *Tipulidae*.—We now come to a very abundant family, both in present and past times. The *Tipulidae* attained great variety in the Tertiary period, which contained many that are now entirely extinct. The *Tipulidae* are recorded in the Oolite of Solenhofen by Weyenbergh, and from the Lias and Purbecks by Brodie, Westwood and Murchison. I have also found a specimen in the Wealden, although in a very imperfect condition.

A great many are also recorded from that great storehouse of insects of Tertiary times—viz., amber. Loew has found as many as sixteen species of *Tipulæ* in amber, one of *Macrochile* and four of *Dixa*. *Tipulæ* has also been reported from Aix, Utah, and Italy, and also from Sicilian amber.

It has also been recognised in the Eocene of the Isle of Wight and the larval form at Sieblos.

Fam. *Chironomidae*.—These delicate little flies have been preserved since Mesozoic times, where they seem to have been of not uncommon occurrence. But it is not until we get to the Tertiary ambers that we find them in any abundance. They are recorded from the English Purbecks and from the Lias of Dobbertin. It is also probable that *Rhiphus priscus*, described by Brodie, and mentioned above, belongs to this family, and not to the *Rhyphidae*. If so, this adds another one to the list of Mesozoic forms of this family.

Fam. *Culicidae*.—Two imperfect specimens from the English Purbecks are referred by Brodie to this family. One to the genus *Culex*, namely, *C. fossilis*, has the antennæ and legs well preserved, but the wings are entirely absent.

Of course, the amber has preserved many genera and species, especially in Aix and Utah, and in the Tertiaries of the Isle of Wight.

Fam. *Bibionidae*.—This family is reported to occur in Mesozoic strata by Geinitz, who figures a species under the name of *Protomyia dubia*, from the Lias. Scudder, however, says this is not a Dipteron at all. So we must at present only consider this family as a Tertiary one. But in Tertiary times this must have been a very abundant

family, especially in specimens, but not so in species, for as many as a thousand specimens have been alone found at Florissant, according to Scudder. But amongst these thousand there are only fifteen to twenty species.

Bibio is one of the most plentiful genera, and is abundant at Oeningen. They are rare in amber, but abundant in the Tertiary rocks.

Fam. *Simuliidae*.—In the Purbecks of England two species of this family have been preserved, namely, *Simulium humidum* and *Simulium priscus*.

Others are also found in the Tertiaries.

Fam. *Mycetophylidae*.—This family, again, is found in the Mesozoic period, several genera having been described by Brodie under the names *Platyura* = *Adonia* of Giebel, and *Macrocerata* = *Sama* of Giebel. Another genus, *Thiras*, now extinct, has been figured by Westwood. In the Tertiary formations these flies appear abundantly, many of which are now extinct as generic types. They are found both in the amber and Tertiary rocks, the species being generally distinct in the two modes of preservation. For instance, *Sciobia*, *Aclada* and *Heterotricha* are genera peculiar to the amber, not being found in the rocks.

A great number of species have been described, and from very wide localities, especially from Aix, Utah, Wyoming, Oeningen, Florissant, and England.

Fam. *Cecidomyidae*.—Members of this family have mostly been found in amber, there being no record of them in Mesozoic times.

Fam. *Syrphidae*.—It is somewhat doubtful if this family is really represented in time earlier than the Tertiary. Two species have been referred to the Syrphidae from the Mesozoic rocks; one from the renowned rocks of Solenhofen, which, according to Weyenbergh, is a *Cheilosia*, another has been figured by Brodie from the Purbeck that may possibly belong here, but being only fragmentary, its true nature remains very doubtful. The following genera are present in the Tertiary beds, viz., *Xylota*, *Cheilosia*, *Volucella*, *Rhingia*, *Syrphus*, and *Eristalis*.

The following table, taken from part of Scudder's table of the Geological distribution of insects in his systematic review of their fossil remains, shows the range and time of origin of the four great divisions of Diptera.

Diptera :	Trias.	Lias.	Oolite.	Cret.	Tertiary.	Recent.
1. Eproboscidea	—
2. Cyclorrhapha	—	—	—	—
3. Brachycera	—	—	—	—	—
4. Nematocera	—	—	—	—	—	—

It is here seen that the first traces of flies are to be met with in the Lias. No doubt future discoveries will place the date of appearance at least in the Trias, or possibly even in the later Palæozoic rocks.

At present there is only one hexapod order in the Palæozoic rocks known, namely, the *Palæodictyoptera*, which became extinct in Triassic times. It may be that from these *Palæodictyoptera* all the existing orders became differentiated. They die out, as I said before, in the Trias, and are there replaced by Orthoptera and Neuroptera, to which they present close affinities. So far no Diptera, Lepidoptera, Hemiptera or Hymenoptera have been discovered prior to Liassic times. From this fact some weight may be given to the assumption that the existing orders were differentiated in the Triassic period.

The Orthoptera and Neuroptera were the most abundant Mesozoic forms, and are now replaced by the more highly developed orders, such as Lepidoptera, Coleoptera, and Diptera.

As to the point where the Diptera deviated from the ancestral order, we are at present in the dark; but further researches in the rocks of new localities may in time throw light on this interesting point.

In another chapter we will see if the Embryology of the flies throws any light on their phylogeny.

CHAPTER II.

CLASSIFICATION OF DIPTERA, WITH AN INTRODUCTORY ACCOUNT OF THE ANCIENT AND MODERN CLASSIFICATION OF INSECTA.

THE classification of all animals must necessarily be subject to continual change and re-arrangement, as the discovery of new species and genera, and the study of known forms, takes place. It is usually a matter of no little interest to compare the ancient and modern methods of arrangement, and as the Diptera, with the rest of the Insecta, have been subject to much alteration in their systematic position, we will here consider the old modes, and also in some degree follow the rise of Entomology. Several hundreds of years B.C., insects had attracted the study of the philosophers, but as all the works were burnt in the libraries, we are comparatively in the dark upon the subject, prior to the time when the great naturalist, Aristotle, wrote. We glean from his writings that much was known before his time of the subject of Entomology. Pliny also tells us that Hippocrates, in the 80th Olympiad (5th century B.C.), wrote on insects. To Aristotle we are indebted for the first account of the Diptera; he divided them into two great sections, making the defensive weapon the point of difference. Section I. he called *Emprosthocentra*, and II. *Opisthocentra*; the former, he said, possessed an oral sting, the latter an anal.

A great number of men immediately following Aristotle wrote on insects, both in Greece and Rome, amongst whom we may mention Democritus, Meander of Heraclea, Virgil, Fabianus, Pliny, and M. Varro.

Pliny classified insects into three groups :

1. Flying insects,
2. Naked-winged insects,
- and 3. Protected-winged insects,

his eleventh book being entirely devoted to insects. Some few unimportant writers followed, but until we reach the sixteenth century

little progress is discernible in this science, unless it be in Arabian. As the old longing for art and science left Greece and Rome, it went to some extent to Arabia, and here we find some considerable advance in the study of insects; amongst those Arabian botanists whose names are known for their valuable knowledge of plants, and who likewise paid no little attention to insects, must be mentioned Rhazes and Avenzoa.

The "dark ages" pass on, and what advance the study made then we are unable to say. Not until about 1520 do we find the subject renewed. In 1549 Agricola published his "De Animalibus Subterraneis," and in this we find the earliest systematic arrangement of insects. Agricola in this work divided them into walking, flying, and swimming groups, and he described a good many species. Again, in 1557, another important work was brought out, namely, "De Differentiis Animalium," in which an account of the insects appeared. About fifty years later the Professor of Medicine at Bologna, Aldrovandus, wrote a large folio volume on insects, "De Animalibus Insectis," and his work was notable for the illustrations (woodcuts). He was undoubtedly an enthusiastic entomologist; it is said he kept a painter for thirty years, whose sole employment was delineating his specimens. Aldrovandus classified the insects in two groups:

1. Favica (terrestrial),
2. Non-favica (aquatic),

and formed orders according to the arrangement of the wings and feet. Following Aldrovandus came Frenzius, who, in 1612, classed the insects in three great groups, which he named aerea, aquatica, and terrea et reptantia. Some entomologists then seem to have paid attention to certain Diptera. Redi, in 1671, gave a good account of several lice, parasitic upon birds, in his "Experimenta circa Generationem Insectorum," and soon after Sangallo wrote a paper on the gnat (*Culex pipiens*), illustrated by a plate.

About this period the microscope began to come into use, and many important physiological features in the insects were discovered, notably the circulation of the blood. The use of the microscope made great advances in the study of insects. The use, however, of magnifying power was known before this, for numbers of years. Amongst those who worked at the period on the microscopical investigations of insects were Power, Hooke, and Hartsoeker. Hooke, in 1665, published his "Micrographia," a work relating to the microscopical structure of insects.

We must now consider that great anatomical entomologist, Swam-

merdam, who, after years and years of work, brought out his "Historia Insectorum Generalis." It was first published at Utrecht in 1669. This work was afterwards published in French, Latin, and English. At first the value of this publication was not known, and no one would publish it in England until 1758, and it was then printed with the edition of the "Biblia Naturæ." The scheme of arrangement presented in this work is very different to any preceding author. He classed the insects in four groups:

- 1st Group or Class : No change of form, but which quit the egg in the same state and appearance they are to retain during life (Spiders, onisci, etc.).
- 2nd Class : No wings on leaving the egg ; other members formed ; after passing out of a nymph state wings appear and the insect can breed (Locusts, dragon-flies).
- 3rd Class : Animal is in a disguised state before issuing from the egg, and then eats and grows, forming the members of the insect into which it is to be converted under the skin, and which it leaves, and then it is the pupa or chrysalis (Moths, etc.).
- 4th Class : The pupa retains two skins, one the larval (Ichneumon).

In 1688 Blankaart's "Schou Berg der Rupsen, Wormer, Maden, etc.," was published. This Dutch physician in this work gave an account of many larvæ, including a dozen fly larvæ. The plates in this are wonderfully executed for the age.

The eighteenth century produced many great entomologists, and at the end we shall see an immense advance in entomological knowledge. At first came Ray, Lister, and Reaumur.

Ray's great work was "Historia Insectorum," published in 1810, after his death, by Dr. Derham. This great naturalist divided the insects into two sections :

- (1) Those that undergo transformation in their form.
- (2) Those that do not pass through any transformation after being produced in the first instance.

He formed his orders according to a number of characters, such as the feet, the habits, odour, larvæ, etc. He included the Vermes in his classification of insects. He may have considered these included Vermes as the larval stages of insects.

Between 1734 and 1742 Reaumur published a five-volume work entitled "Mémoires pour servir à l'Histoire des Insectes." This work contained as many as two hundred plates, and was the best work published so far. There were two editions, one in French and another in Dutch. This work of Reaumur's put fresh energy into the entomologists of the Continent.

Almost at the same time as Reaumur's writings there commenced to appear papers by the great Swedish naturalist, Linnæus. In 1735 he published the first edition of his renowned and valuable work,

“*Systema Naturæ*.” In this edition he classified insects into four classes. The first he called the *Coleoptera*, the second the *Angioptera*, the third the *Hemiptera*, and the fourth the *Aptera*.

The *Coleoptera*, or covered wings, included the beetles. The *Angioptera*, or naked-winged insects, were the moths and butterflies. *Aptera*, having limbs but no wings, included the spiders, fleas and lobsters, etc., whilst in the *Hemiptera* he placed such insects as the bugs and locusts. In this first edition we see he includes other orders, namely, *Vermes*, *Mollusca*, and *Echini*; thus somewhat following *Reaumur*. This we must notice as a curious piece of retrogression, as even Aristotle saw the difference between many of these, and classified the sea-urchins in a different class to the insects.

Finally, in the edition of 1767 he classified insects in seven orders instead of four, and at the same time took away the *echini*, etc., from the class *Insecta* and placed them in a class called the *Vermes*. This class, then, is seen to contain a great number of most varied forms. We find here worms, *Cælenterates*, *Polyzoa*, *Mollusca*, *Echinoderms*, etc., all mixed up together.

His seven orders of insects were the following :

1. *Coleoptera* ; 2. *Hemiptera* ; 3. *Lepidoptera* ; 4. *Neuroptera* ; 5. *Hymenoptera* ; 6. *Diptera* ; 7. *Aptera*.

And thus we see our present arrangement of orders is nearly parallel to this.

Another arrangement of the insects, of no value, but of some interest, is that published by Dr. Hill in his “*History of Animals*.” He divided the class *Insecta* into three groups, namely :

1. *Aptera*, having no wings.
2. *Pteraria*, winged.
diptera, two-winged flies.
tetraptera, four-winged flies.
3. *Gymnarthridia*, soft bodied, with legs.

Then followed a most remarkable system of classification, well known on the Continent as the *Scropoli System*. This was brought forward in a work entitled “*Introductio ad Historiam Naturalem*,” in 1777. Scropoli followed the arrangement of Linnaeus; but his nomenclature was very different, and afterwards alterations were made. He seemed to consider each order should be coupled with the name of the entomologist who has worked at it; and thus we find the following curious arrangement, which met with some success on the Continent (he made five orders) :

1. *Swammerdamii*—lucifuga.
2. *Geoffroy*—gymnoptera.

3. Roeselii—lepidoptera.
4. Reaumurii—proboscidea.
5. Frischii—coleoptera.

He started by changing the Linnæan names Hemiptera, Hymenoptera, Diptera to Proboscidea, Aculeata, and Halterata respectively. His first order (Lucifuga) included the Crustacea ; the second the Halterata, Aculeata, and Caudata ; the third the genus Sphinx, Phalæna, and Papilio. The two last divisions were respectively divided into terrestrial and aquatic.

Another author who greatly improved this study was Schaeffer, who in his publications between 1764 and 1777 gave to the world some valuable instruction in the mode of insect-collecting and in the description of the microscopes used. He also described a large number of species to illustrate his system of classification, which differed considerably from the Linnæan method, and which became of some repute. He formed seven orders, the characters of which it is not possible to give here. The following are the seven orders :

1. Insecta coleoptero-macroptera.
2. " coleoptero-microptera.
3. " coleoptero-hymenoptera = hemiptera.
4. " hymeno-lepidoptera.
5. " hymeno-gymnoptera.
6. " diptera.
7. " aptera.

About the latter end of the eighteenth century a good many lists of species had been published, both in England and abroad, and the science of entomology made great strides, but as yet no specialists of any repute had come forward. Entomologists were, in fact, only finding out some systematic base to work upon. As we have already seen, a large number of varied modes of arrangements had been formed, only one of which, the Linnæan, being taken into any account at the present day. A man destined to overthrow the Linnæan system for a short time, and whose classification is still considered of great value, appeared at this period, namely, Fabricius, who in 1775 brought forward his novel classification in his work entitled " *Systema Entomologica*. " The mode of classification that he adopted was by the characters of the mouth parts. He continued to publish a large number of systematic works, each one containing a modified arrangement of the preceding, and in his last work the insects were divided into the following thirteen orders : 1. *Eleutherata* ; 2. *Ulonata* ; 3. *Synistata* ; 4. *Piezata* ; 5. *Odonata* ; 6. *Mitosata* ; 7. *Unogatæ* ; 8. *Polygnata* ; 9. *Kleistagnata* ; 10. *Exochnata* ; 11. *Glossata* ; 12. *Rhyngota* ; 13. *Antliata*.

Fabricius wrote in both Latin and German. We must not forget to mention before leaving the present century the great work commenced in 1792 by Donovan; this work, entitled "The Natural History of British Insects," not being completed until 1809; it was a great advance in our knowledge of insects of our own country.

As we get into the nineteenth century we find a great series of advances being made, more especially during the last fifty years. In 1800 many valuable entomological works were published, amongst which we must notice the "Fauna Suecica" and Cuvier's "Anatomie Comparée," which treats the insects fully. Cuvier also formed a new arrangement on the Fabrician system. He divided insects into two classes:

1. Those with jaws.
2. Those without jaws.

Another valuable work appearing in this year is Donovan's "Insects of India." In the year 1801 Lamarck moulded another theory of classification, making the mouth parts his centre of observation. He formed three classes, namely: 1. That in which the insects had mandibles and jaws; 2. Those with mandibles and a kind of trunk. 3. Those having a sucking apparatus. He also classified the Coleoptera into three sub-families, according to the joints of the feet. He also removed the Linnæan *aptera* to a class preceding the Insecta.

In the following year we find works appearing more abundantly on special orders, such as Marsham's "Coleoptera" and Kirby's "Apum Angliae." Henceforth from the period we have now reached, we find countless entomological works, both general and specialistic, by such men as Centis, Westwood, Kirby, Zittel, and hundreds of others. The formation of the Entomological Society in London, in 1838, gave a fresh impetus to the study, and now in all parts of the world we find entomological societies, with their valuable record of observations published in the transactions.

We must now pass on to the more important part of this chapter to us, namely, the account of the classification of Diptera. We have seen that Aristotle classed them in two great sections, and the various names under which they have been known, some of which still cling to them at the present day. Very little work is seen to have been done in England in this order, as is seen by the absence of literature, but on the continent the Diptera began to receive much attention in the early part of the nineteenth century. Meigen, in 1820, added greatly to the knowledge of flies by the publication of his great work in six volumes of "European Diptera." Then followed the descrip-

tions of a large number of European and Exotic genera and species, and thus a foundation for a satisfactory classification was arrived at.

Latreille was one of the first who attacked this subject in a scientific way, and he worked at the affinities of the group. He based his classification on the trophi and the transformations. Macquart classified the Diptera as follows :

Division 1. *Nemocera* = *Tipulidæ* and *Culicidæ*.

2. *Brachycera*.

" Sub. Div. i. *Hexacheta* (six setæ in mouth).

" " ii. *Tetracheta* (four ditto).

" " iii. *Dicheta*.

Latreille, in his "Familles Naturelles," classified them according to their metamorphosis, and divides them into four families, viz.: 1. *Nemocera*; 2. *Tanystoma*; 3. *Notacantha*; 4. *Athericera*.

Number three including the *Stratiomydæ*. This arrangement of Latreille's is nearly followed by Westwood in his "Introduction to the Modern Classification of Insects" (1840). He divides the flies into the following two sections :

Section 1.—Head always distinct from thorax. Claws of tarsi not dentated. Larvae develop outside the parent.

Section 2.—Head immersed in the thorax. Claws denticulate. Larva nourished in the parent.

Section 1.—A. *Nemocera*. (Stirps 1.)

Antennæ having more than six joints. Palpi four to five jointed = *Culicidæ* *Pipulidæ*.

B. *Brachycera*.

Antennæ having not more than three joints. Palpi one to two jointed.

(Stirps 2.) *Notacantha*.

Antennæ apparently composed of only three joints; last joint articulated. Proboscis exserted, seldom enclosing more than two lancets. Structure of the mouth very incomplete, and number of setæ variable. Pupa coarctate; the skin of the larva nearly retaining its previous form = (*Stratiomidæ*, etc.).

(Stirps 3.) *Tanystoma*.

Antennæ only three-jointed, terminated by a seta. Proboscis exserted generally with four setæ. Pupa incomplete = (*Tabanidæ*, *Bombyliidæ*, *Empidæ* *Leptidæ*, *Dolichopodidæ*, etc.).

(Stirps 4.) *Athericera*.

Antennæ with only two or three joints, terminated

by a seta. Proboscis generally withdrawn into a cavity, with two setæ. Pupa coarctate = (*Syrphidae*, *Conopidae*, *Muscidae*).

Section 2.—(Stirps 5.) *Pupipara* = *Homaloptera* (Leach).

Head immersed in the thorax. Claws denticulated.

Larvæ nourished in the mother = (*Hippoboscidea*, etc.).

Since Westwood's classification (1840) several alterations have been made. In 1851 Walker's "Diptera, Insecta Britannica," in three volumes, was published. This is the fullest account of British flies that has been published. A great number of species are described in it, many of which seem to be of doubtful repute. In this work, which is, unfortunately, out of print, the following classification is adopted. The Diptera are divided into three groups: 1. *Suctoidea*; 2. *Proboscidea*; 3. *Eproboscidea*, according to the following characters:

An-	tennae:	{	Lying flat in cavities at the sides of the head	-	1
			Seated in front of the head.	Legs { close, side by side	- 2

the head.

Legs { distant - - - 3

The second group, or the Proboscidea, is divided into three sections: 1. *Nemocera*; 2. *Brachycera*; and 3. *Hypocera* (*Phoridae*).

It will be seen that this third section is done away with in Verrall's list, and that the family *Phoridae* is placed in the Proboscidea, just in front of the Eproboscidea.

The *Aphaniptera*, or fleas, are included in the Diptera by Walker, who enumerates fourteen species; while Verrall, in his recent list, only mentions thirteen species in this family. It will be seen that a large number of species mentioned by Walker are cut out by Verrall, as he considers their record doubtful.

In Kirby's "Text-book of Entomology" (1885) the Aphaniptera are also included in the order Diptera. In this book is also mentioned Westwood's order, the *Achreioptera*, as being possibly included here. They are not, however, British insects, being parasitic on the beaver and somewhat resembling a small cockroach.

This author divides the Diptera into four sub-orders, namely:

1. *Diptera Aphaniptera*.
2. " *Nemocera*.
3. " *Brachycera*.
4. " *Homaloptera*.

The most recent classification is that adopted by Verrall, published in 1888,* and it is this classification we intend to use.

* "A List of British Diptera." By H. Verrall, F.E.S., 1888 (Pratt & Co.). This classification was introduced by Brauer.

Here the order Diptera is divided into two great sections; one the *Orthorrhapha* and the other *Cyclorrhapha*.

The *Pulicidae* will be seen to be included in the *Nematocera*, and several other small differences from former methods of systematic arrangement.

I. ORTHORRHAPHA.

A. NEMATOCERA.

- Fam. 1. *Pulicidae*.
- „ 2. *Cecidomyiidae*.
- „ 3. *Mycetophilidae*.
- Sciarinæ.
- Mycetophilinæ.
- Sciophilinæ.
- Ceroplatinæ.
- Macrocerinæ.
- Bolitophilinæ.
- Mycetobinæ.
- Diadocidinæ.
- Fam. 4. *Bibionidae*.
- „ 5. *Simulidae*.
- „ 6. *Chironomidae*.
- „ 7. *Orphnephilidae*.
- „ 8. *Culicidae*.
- „ 9. *Dixidae*.
- „ 10. *Ptychopteridae*.
- „ 11. *Limnobidae*.
- Limnobinæ.
- Rhamphidinæ.
- Eriopterinæ.
- Limnophilinæ.
- Amalopinæ.
- Cylindrotominæ.

- Fam. 12. *Tipulidae*.
- „ 13. *Rhyphidæ*.

B. BRACHYCERA.

- Fam. 14. *Stratiomyidae*.
- Pachygastrinæ.
- Clitellarinæ.
- Stratiomyinæ.
- Sarginæ.
- Berinæ.

Fam. 15. *Xylophagidæ.*
 „ 16. *Tabanidæ.*
 „ 17. *Asilidæ.*
 Dasypogoninæ.
 Laphrinæ.
 Asilinæ.
 „ 18. *Bombylidæ.*
 „ 19. *Theroviidæ.*
 „ 20. *Scenopinidæ.*
 „ 21. *Cyrtidæ.*
 „ 22. *Empidæ.*
 Hybotinæ.
 Empinæ.
 Ocydrominæ.
 Tachydrominæ.
 „ 23. *Dolichopodidæ.*
 „ 24. *Lonchopteridæ.*

II. CYCLORRHAPHA.

C. PROBOSCIDEA.

Fam. 25. *Platypezidæ.*
 „ 26. *Pipunculidæ.*
 „ 27. *Syrphidæ.*
 „ 28. *Conopidæ.*
 Conopinæ.
 Myopinæ.
 „ 29. *Œstridæ.*
 „ 30. *Tachinidæ.*
 Phasinæ.
 Gymnosominæ.
 Phaninæ.
 Ocypterinæ.
 Tachininæ.

Fam. 31. *Desidæ.*
 „ 32. *Sarcophaginæ.*
 „ 33. *Muscidæ.*
 „ 34. *Anthomyidæ.*
 Mydæinæ.
 Anthomyinae.
 Homalomyinæ.
 Cœnosinæ.
 Fam. 35. *Cordyluridæ.*

Fam. 36. *Phycodromidæ*.
 „ 37. *Helomyzidæ*.
 „ 38. *Sciomyzidæ*.
 „ 39. *Psilidæ*.
 „ 40. *Micropezidæ*.
 „ 41. *Ortalidæ*.
 Ortalinæ.
 Platystominæ.
 Ulidinæ.
 „ 42. *Trypetidæ*.
 Dacinæ.
 Trypetinæ.
 „ 43. *Lonchæridæ*.
 „ 44. *Sapromyzidæ*.
 „ 45. *Heteroneuridæ*.
 „ 46. *Opomyzidæ*.
 „ 47. *Sepsidæ*.
 „ 48. *Piophilidæ*.
 „ 49. *Geomyzidæ*.
 „ 50. *Ephydridæ*.
 Notiphilinæ.
 Hydrellinæ.
 Ephedrinæ.
 „ 51. *Drosophilidæ*.
 „ 52. *Chloropidæ*.
 „ 53. *Agromyzidæ*.
 „ 54. *Phytomyzidæ*.
 „ 55. *Astiadæ*.
 „ 56. *Borboridæ*.
 „ 57. *Phoridae*.

D. EPROBOSCIDEA.

Fam. 58. *Hippoboscidæ*.
 „ 59. *Braulidæ*.
 „ 60. *Nycteribidæ*.

Fam. *Psychodidæ* ought to be inserted between Fam. 7 and 8.

Fam. *Milichidæ* is given in the list of reputed British species.

Another list of Diptera was published by Walker in 1874, but this includes Diptera of all parts of the globe. Morris also published a list nearly half a century ago. As far as I can find out these are the only lists of Diptera in English of any importance.*

* B. Cooke has also published a catalogue of the Diptera of Lancashire and Cheshire. Proc. Ent. Soc. Lanc. Ches., 1881. Also numerous other local lists, as in the Fauna and Flora of Hastings, etc.

In the *Orthorrhapha* the pupæ escape by a T-shaped rent in the larval skin. The larva has in this division a more or less perfectly developed chitinous head. In the *Cyclorrhapha* the pupæ escape from the larval skin by a circular opening, and the larva has no chitinous first segment, but is quite acephalous.

Quite recently (1891)* Osten-Sacken has adopted a new method of classifying the first of Brauer's sections of the Diptera; namely, the *Orthorrhapha*, as he considers the attempts made by Schiner and Brauer at dividing this sub-division of the Diptera into smaller groups as unsatisfactory. The latter authors based their groups on characters of subordinate value, taken from the wings and larvæ, "without sufficient regard for the organization and affinities of the imagoes."

Osten-Sacken considers that the study of the organs necessary for the functions of external life will lead to a natural arrangement, such as the eyes and antennæ, wings and legs.

He divides the *Nemocera* into two: (i.) the *True Nemocera*, including the *Cecidomyidæ*, *Mycetophilidæ*, *Culicidæ*, *Chironomidæ*, *Tipulidæ*, *Psychodidæ*, and possibly the *Dixidæ*, may form another family in this group. The remaining families he calls (ii.) *Nemocera anomala*, these being archaic forms, and having a peculiar geographical distribution.† They also have a different structure to the *True Nemocera*.

The following are the chief characteristics of the *True Nemocera*:

- i. Head never holoptic, and thus the difference in size between the male and female head and the difference in the size of the eyes is very small or absent.
- ii. The eyes are round, oval, or lunate. They may meet, but never in such a way as seen in the holoptic head of the *Nemocera anomala*.
- iii. Antennæ very large in proportion to the small head.
- iv. Legs very often long, generally thin and weak, and not fitted for walking, as seen in the *Tipulidæ*.
- v. Generally more slender and lighter than the *Nemocera anomala* (compare *Tipula* and *Bibio*) in general appearance.
- vi. Geographical distribution world-wide; most inhabiting damp and shady places, and prefer the latter part of the day for flight.

* *Vide Ent. Mo. Mag.*, Feb., 1891.

† The *Bibionidæ*, for instance, were at their maximum in tertiary times. Giard has given an account of this family in his "Note sur les Bibionidæ Fossiles." *Bull. Sc. Dép. Nord.*, tome i., 1878.

The *Nemocera anomala* are characterized by the following distinctive features :

- i. Head holoptic, both in the male and female, but chiefly in the former. In *Bibio*, for instance, the ♀ has non-holoptic eyes.
- ii. Eyes often bisected, the upper facets being the larger. These two halves may be separated by a smooth, unfaceted stripe, as in the ♂ *Bibio*.
- iii. Legs well adapted for walking, and often, as in *Bibio* and *Simulium*, thick.
- iv. Male and female generally differ very much.
- v. Peculiar, often sporadic geographical distribution.

Upon these characters Osten-Sacken has founded the two divisions of the *Nemocera*. Both from these characters, their curious distribution, and their archaic nature, we see that this division is quite a natural one, and is founded on more scientific principles than most entomological classifications. Amongst the *Orthorrapha Brachycera* he classifies the following families into one group: the *Tabanidae*, *Stratiomyidae*, *Acanthomeridae*, *Leptidae* (plus *Xylophagidae*). For a long time these families have been converging towards one another, and at last have been united under the name (given by him) *Eremochæta*. This seems a natural group, and is founded on a chætotactic character; namely, the total absence of *Macrochætae*.

Besides the bristleless nature of these forms, they are separated from the *Nemocera* and remaining *Brachycera* by the following characters, given by Osten-Sacken :

1. The eyes in the male are predominantly holoptic. There are, however, a few exceptions to this rule given by him; viz., *Xylophagus*, some Australian *Chiromyzæ*, *Hermetia*, etc. But *Cænomyia*, a close relation to *Xylophagus*, has holoptic eyes.
2. The variegated colour of the eyes, especially seen in *Stratiomyidae* and *Tabanidae*.
3. The extreme variability of the antennæ, on the one hand related closely to the *Nemocera*, and on the other to the *Cyclorrhapha*.
4. Three well-developed pulvilli are generally present. Legs smooth, and having no bristles, as seen in the *Asilidae*, *Bombylidæ*, etc.

The following, then, are the families recently grouped by Osten-Sacken :

i. <i>Nemocera</i> .	ii. <i>Nemocera anomala</i> .
Cecidomyidæ.	Bibionidæ.
Mycetophilidæ.	Simulidæ.
Culicidæ.	Blepharoceridæ.
Chironomidæ.	Rhypidæ.
Psychodidæ.	Orphnephilidæ.
Tipulidæ.	
Dixidæ (?).	
iii. <i>Eremochæta</i> .	
	Stratiomyidæ.
	Tabanidæ.
	Acanthomeridæ.
	Leptidæ (plus <i>Xylophagidæ</i>).

The family *Xylophagidæ* must be given up and united to the *Leptidæ*.

As we receive more material from the tropics and foreign parts we shall continually find it necessary to alter the classification. The old classification has been adopted to suit European forms; but as the numerous anomalous forms from Chili and North America have shown that the present classification will not hold good, we may expect still further changes when new material is brought from Australia, Africa, and other places, where the Dipterous fauna is scarcely known. It is by the study of exotic forms that we shall eventually arrive at a satisfactory classification, and only by this means. In a letter we received from Mr. Coryndon Mathews we are told as follows: "Only a month or two ago Major Yerbury sent me a box of flies from Trincomali, Ceylon, for identification, and amongst some fourteen or fifteen *Asilidæ*, there was material enough to upset three of Schiner's and Rondani's genera."

The immense importance of the study of foreign species in regard to the classification of flies is thus emphasised; and until we are well acquainted with the Dipterous fauna of all parts of the globe we shall still be in the same changeable and unsatisfactory state in regard to their systematic arrangement.

For the present we cannot do better than follow Brauer's arrangement, especially as it has been adopted in the only list of British species.

CHAPTER III.

APHANIPTERA.

(NOW INCLUDED IN NEMATOCERA.)

THE Aphaniptera are also known under the following names :

Suctoria, De Geer.

Siphonaptera, Lat.

Aptera, Lam.

The following may be taken as the characters of the section or sub-order and thus of the family PULICIDÆ :

Parasitic, with scale-like rudimentary wings, the metathoracic scales being the largest. Tarsus five-jointed; antennæ small; mouth formed for suction, composed of mandibles and lingua, long; maxillæ small, in form of triangular scales with four-jointed palpi; labium minute, three-jointed; palpi four-jointed.

There are four genera : 1. *Pulex*; 2. *Sarcopsylla* (the latter not being British); 3. *Hystrichopsylla*, and 4. *Typhlopsylla*.

The history and changes of the "fleas" have been known since the days of Aristotle. He noticed their distinct sex, and that they produced $\sigma\kappa\alpha\lambda\eta\varsigma$ $\delta\omega\iota\delta\epsilon\iota\varsigma$. He did not trace the changes of this insect far enough, and thus fancied this progeny was *sui generis*. He also thought that the adults were generated in the earth spontaneously. This spontaneous generation has been held up by many naturalists since his time, and has been applied to many of the invertebrate animals. I have even, in this nineteenth century, heard people talking of the spontaneous generation of "green fly" and locusts; but happily this absurd notion is only lingering on amongst very few people. Few animals have had so many theories applied to their origin as the common flea; Scaliger thought they were produced from humours amongst the hairs of dogs. By degrees their true history became known, and to De Geer we are indebted for one of the first good accounts of their transformations. They have attracted attention in all parts of the world. They were formerly thought to

live only upon vertebrate blood, but recent discoveries show this to be a fallacy. They are found in large colonies in dry sandy places, where they could not attack vertebrate animals. To make up for this they make for caterpillars and other invertebrata, and suck their juices. There are a good many species, each animal seeming to have a particular one to itself. They may attain a great size, such as *Pulex gigas*, from America ; but our species never attain any great dimensions. By far the greater number belong to the genus *Pulex*, but one that has attracted considerable interest forms another genus, *Sarcopsylla*. This genus contains the curious and obnoxious "Jigger" of South America and Africa, so well described by Waterton in his "Wanderings." Although this is not a British insect, a short description is appended, as its history is so extremely interesting.

Metamorphosis of the Flea (Pulex).

Each female lays about a dozen eggs at a time. The eggs are oblong, or spindle-shaped, and generally whitish in colour. They may be, however, brown in some species. The ova are deposited in



FIG. 1.—Larva of *P. felis* (enlarged).—*a*, antennæ ; *P*, pointe frontale.

various places, such as the cracks in boards, amongst dust, on the hairs of rugs and dogs, and various other places, according to the species.

After a time these eggs hatch, and from them come worm-like maggots, very active. The larva is composed of thirteen segments, and is quite apodous (Fig. 1). The last segment may have two strong, curved hooks ; the head is sub-ovate and corneous. Antennæ and oral appendages are present ; also a pair of eyes.

Although these worm-like larvæ are active, they never move far, and their mode of nutrition has been disputed and discussed a great deal. It seems true that the female, or mother, after having gorged itself upon the blood of its victim, makes off to its larvæ, and there disgorges some of its feast. This congealed blood is often found by the larvæ, and upon it they feed. It is also said that they gain nourishment from the fleshy part of feathers, etc., which may happen to be close to them.

Between the twelfth and fourteenth days the larvæ may spin themselves a small silken cocoon, which lies in and is covered by the dust. Not all spin this silken cocoon; some pupate into naked, immobile nymphs, which gradually assume a darker colour, and approach the appearance of the imago. About the seventeenth day of pupal life the imago emerges, and very soon commences its rapid hopping movements and voracious habits.

All the larvæ do not pupate at the same time. Some live through the winter and hatch in the spring.

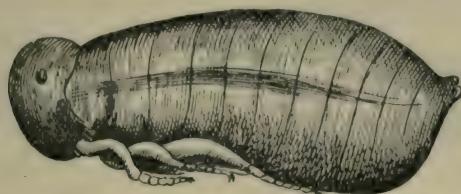


FIG. 2.—Pupa of *Pulex irritans* (greatly enlarged).

Classification.

Verrall, in his list of British Diptera, 1888, includes the "fleas" in the Nematocera, and thus does away with the old sub-order, Aphaniptera. The family *Pulicidæ* is divided into three genera, and numbers thirteen species in all, viz. :

Fam. *Pulicidæ*.

Genus 1. *Pulex*, L.

Irritans, L.

Fasciatus, Bosc.

Gallinæ, Bouché.

Melis, Wlk.

Sciurorum, Bouché.

Canis, Dugès.

Erinacei, Bouché.

Goniocephalus, Tasch.

Genus 2. *Hystrichopsylla*, Tasch.

Obtusiceps, Rits.

Genus 3. *Typhlopsylla*, Tasch

Octactenus, Kolen.

Hexactenus, Kolen.

Musculi, Dugès.

Gracilis, Tasch.

Genus I.—*PULEX*.

Characters of the Genus.—Body oval and compressed, and covered by a hard, chitinous integument, which is covered by hairs and bristles on the back and legs. There are thirteen segments, and they are continuous, there being no distinction into thorax and abdomen.

Head small. Mouth suctorial. Upper lip obsolete (unless the lingua represents it). The mandibles are in the form of two flat setæ, with a central rib and serrated edges. The lingua is the same length as the mandibles, the three forming a piercing, or puncturing

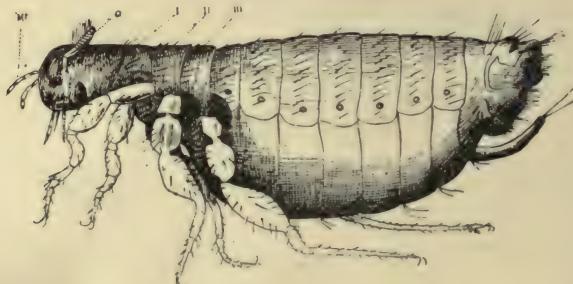


FIG. 3.—Imago of *Pulex* ♀.—*a*, antennæ; *mt*, maxillary palpi; *i*, *ii*, *iii*, pro-, meso-, and meta-thorax.

organ. When at rest these organs are closed by the labial palpi, which form a tubular *haustellum*. These arise from a small labium, which comes from a very small mentum.

The maxillæ are sub-triangular appendages, and are coriaceous and are situated at the side of the mouth. They have large maxillary palpi arising from the base, composed of four joints, and formerly mistaken for antennæ.

Eyes small (= simple ocelli) and round. Antennæ are placed in pits behind the eyes. These pits are covered by movable valves. At times the antennæ may be withdrawn out of these cavities. They are four-jointed appendages, the third joint being small and cup-shaped. The terminal joint is often transversely striated.* They vary in different species.

The thorax is composed of three typical segments, but more distinctly marked than in other insects. On the second, or mesothoracic, is the first pair of scales, or rudimentary wings, and on the metathoracic segment we find the large scales representing the hind

* These striations are really joints.

wing (haltere) of the Diptera. This is a point worth noticing, that in these Diptera the posterior rudiment is more developed than the anterior, contrary to the usual arrangement of the wings in flies.

Legs, long and strong; the posterior pair formed for leaping. Coxæ large. At the four hind legs the coxæ articulate to the epimeræ by means of a supplemental joint, which is absent in the fore leg. The trochanter is small. Strong femora and setose tibiæ ending in five-jointed tarsuses. The terminating tarsal joint bears a pair of unguis, or claws.

Sarcopsylla penetrans (= *Pulex penetrans*).

This species forms another genus in the Pulicidæ. It is an insect that has attracted a large amount of attention owing to its unpleasant habits.

The male is a small and insignificant insect, which does not seem to be parasitic—at least, as far as we can make out from various accounts. They are usually found in damp and swampy places, and breed in great numbers, the ground swarming with them. The female is the insect that has attracted so much notice. They are known as "jiggers," or the "jighoe," and inhabit South America, the West Indies, and the West Coast of Africa, etc. The females attach themselves to the feet of travellers and to animals. They chiefly fasten on to the spaces between the toes and under the nails. As soon as they are attached to the skin they burrow into the flesh, and there excavate a nest and attain a great size, often as large as a pea. It is the abdomen only of the female that enlarges. This enlargement is due to the development of the ova in the body. Unless the "jigger" is extracted before this bursts a very nasty wound is produced, leading to ulcerations, and maybe, the destruction of the bone, and amputation is rendered necessary. Wood, in his "Insects Abroad," scouts this idea; but I am assured that if left to themselves they may produce the most serious wounds and disease. They are, however, easily extracted if paid attention to at once. It seems that the ulceration is set up by the larvæ that are hatched, and escape from the female.

The larvæ live for a certain time in the host, and then are said to pass out and pupate in the ground.

The female is thus seen to be impregnated before she attacks the host, otherwise no effect is produced. When their bodies are fully swollen they very much remind one of the Brazilian honey-ants, which have their abdomen enormously distended by honey.

As such swarms of these "jiggers" are seen in certain localities,

it seems improbable that they can all find human hosts, or even sufficient vertebrates of any kind.

It is said that the species that is found in the dog is different to the one found in man. Whether the species in Africa is different to that in America I do not know.

This was the insect that Waterton found so troublesome during his "Wanderings."

Anatomy of the Larva of Pulex.

In all the species there is a slight difference in the form of the larvæ, but the general arrangement is the same. The type we take is

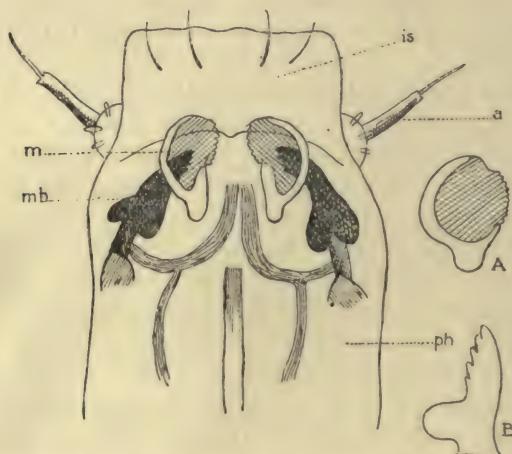


FIG. 4.—Head of Larva of *P. felis*.—*is*, upper lip; *a*, antennæ; *m*, maxillæ; *mb.*, mandibles; *ph*, pharynx; A, maxillæ, and B, mandibles, greatly enlarged.

the larva of *P. felis*, parasitic on the cat. This subject has been fully worked out by Laboulbène and Kunckel, and their researches published in the "Annals of the Entomological Society of France" (2 and 3). The larva, which may attain the length of a quarter of an inch, is usually of a whitish colour, and in some cases so transparent as to allow the alimentary canal to be examined through the integuments (Fig. 1).

The number of body-segments is thirteen, and each is armed by a few setaceous hairs. The last segment is armed also by two strong recurved claws. The head is corneous, and presents certain peculiarities. The antennæ are a fair size; their structure can be seen from the figure (4). There is also developed a pair of maxillæ, with serrated edges, and also a pair of mandibles. The large upper

lip has four setaceous hairs upon its under surface. On the dorsal surface of the head we must be careful to note the curious structure known as the "pointe frontale," so well described in Kunckel's paper. It is present in the young larvæ, and may be seen prior to its exit from the egg. It is a yellowish-brown, horny plate, and seems to vary in shape in the different species of fleas. This appears to have been first noticed by De Geer.*

This little corneous plate is placed in a slight depression of the head, and ends in front in a sharp point: the figure will, however, explain best its general shape and appearance in the species of *Pulex*; namely, *P. felis* (*vide* Fig. 1). It must be noticed that this structure is only found in the young larvæ. It is possibly an organ used to rupture the egg membranes, and thus release the larva. It is no doubt the homologue of the "dorsal plate" found in other insects, so fully described by Kowalevsky,† and again by Dohrn,‡ who says it is formed from a thickening of the serous membrane which covers the dorsal surface; this differs, however, from our "pointe frontale" by becoming formed into a canal and then into a tube. This frontal plate, seen in embryo fleas and in *Pentatomæ*, in the *Phryganidæ*, and as the so-called "dorsal plate" of *Hydrophilus*, etc., is also, according to Kunckel, homologous to a piece which, if it is developed, exists in the front of the larvæ of Crustacea, the Zoæa of *Cancer mænas* and *Pagures* and *Porcellanes*, of young lobsters, etc.

M. Balbiani also notices a curious point in the frontal region of young *Phalangidæ*,§ which he regards as the analogue of the appendages found on the dorsal surface in other Arthropods. We may also note the antennæ situated on the dorsal surface of the head. They are composed of three joints: the first being rounded, and bearing a few protuberances; the second is cylindrical, and ends in tentacular-like processes; from this proceeds the third joint, which is small and pointed.

The Alimentary Canal.—This is easily seen in living larvæ, owing to their transparency. Two small elongated *salivary glands* open into the pharynx, which is followed by a short and swollen *oesophagus*, which gradually narrows as it passes into the *chylific ventricle*; this part of the digestive track is large and elongated, its posterior end is

* De Geer, "Mémoires pour servir à l'Histoire des Insectes," 1778.

† "Embryologische Studien an Würmern u. Arthropoden." Mém. Ac. Imp., Petersbourg, S. vii., vol. xvi., 1871.

‡ "Notizen zur Kenntniss d. Insectenentwickelung." Zeitschrift f. wiss. Zool., 1876.

§ "Mémoire sur le Développement des Phalangides." Ann. Scien. Nat., vol. xvi., 1872.

corrugated ; from this end arises the *small intestine*, which has a double flexure. The *large intestine* is swollen, and its walls are very much folded ; it passes into a narrow *rectum*.

At the base of the chylific ventricle open four *Malpighian tubules*, each being long and coiled.

The Respiratory System consists of two rows of lateral trachea, united to one another by a tracheal tube in each segment. Nine of these connecting tubules send off a tube to the stigmata, and other tubes ramify in other parts of the body.

Nervous System.—We were unable to make out the nervous system of the larvæ examined, so append Kunckel's description verbatim :

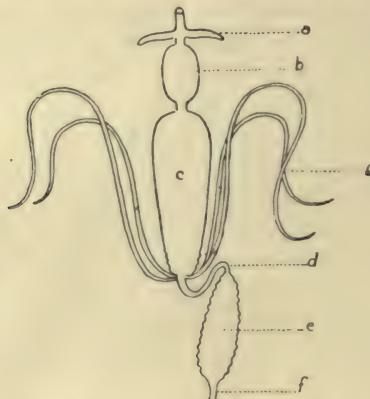


FIG. 5.—Alimentary Canal of Larva.—*a*, salivary gland ; *b*, oesophagus ; *c*, chylific ventricle ; *d*, small intestine ; *e*, large intestine ; *f*, rectum ; *g*, Malpighian tubules.

“ Le système nerveux, composé de ganglion arrondis, reliés par de connectifs, et au nombre d'une paire environ par segment, n'a pas été assez soigneusement étudié pour que je puisse le décrire. Il en est de même du système circulatoire.”

The natural position of the fleas has caused much discussion. Lamarck considered them Diptera on account of their transformation. Dugès considered them nearly related to the Hymenoptera ; others to the Hemiptera, on account of the rostral shield.

Latreille placed the flea between the Hemiptera and Diptera, as did also Westwood, raising them to an order called Aphaniptera (of Kirby). They are now considered true Diptera, and according to Osten-Sacken are a degraded genus of the family to which belong the small *Mycetophila*, that live in mushrooms during their larval state. Their metamorphoses certainly agree in many points. The

fleas are, however, generally classified at the present day as the first sub-order of the Diptera, namely, the Diptera Aphaniptera, being thus placed between the Hemiptera Anoplura, or lice, and the Diptera Nemocera. Verrall, in his list of British Diptera (1888), places them in the Nemocera.

Pulex irritans, L. (the Common Flea).

This is the best-known of all the *Pulicidæ*, and has been described over and over again. The following entomologists have given the best descriptions: Leach, Dugès, Bouché, Rösel, De Geer, Latreille, Newman, Kirby, and Westwood, and the works of these authors may be consulted for more detailed accounts.

The abdomen large, inflated, reddish-brown, with two apical diverging bristles. Bristles developed on each segment, especially on the dorsal surface and around the genitalia. Head short and shining, minutely punctate. Antennæ usually carried in the receptacles; basal part of maxilla thickened; palpi composed of four nearly equal joints. Mandible thickened and horny on one side, with small denticles; thin and hyaline on the other, with numerous deep denticulations.

Legs paler than the body. Coxæ broad and flat, with a few scattered bristles on the upper surface. Femora also broad and flat, hairy; a fringe of bristles on the inner side of the hind pair. Thick apical spines on the tibiæ and tarsi. Ungues fringed on the under surface by little spines (?). The first tarsal joints in the hind legs are the largest; the fifth joints next in size; the second, third, and fourth in decreasing succession. The two fore legs are differently constructed, two and five being the largest joints; the first, third and fourth being nearly equal. The last tarsal joint always armed on the under surface by a few spines—generally four in the common flea.

The *Pygidium* is composed of disc-like areolæ, around which is a ring of rectangular rays.

The male is armed with two stylets for copulation. The mode of copulation may easily be seen, by keeping a number of fleas in a glass test-tube. The coupling takes place tail to tail, the female (which is much larger than the male) stands over the male. The pairing sometimes only lasts a few seconds, but usually much longer.

Leewenhoeck first discovered the spermatozoa of the flea. He described them as "serpent-like animalcules." The flea may easily be dissected in water under the microscope, and the alimentary canal, testis, ovary, etc., easily seen.

They are best mounted in balsam, after being well soaked in

liquor potassæ, then washed and soaked again in *turpentine and oil of cloves*.

Length of *P. irritans*, about 1 lin. This is one of the commonest fleas, and is parasitic on the human race, especially in Europe, where it extends from the Arctic regions to the warmest parts of the Continent.

The larvæ are pearly white and very active; several hairs on each segment; head slightly chitinous and brown; two short, one-jointed antennæ. The last segment armed by two recurved brownish spines. They may be found in the dust, etc., in the crevices of boards.

The pupæ are enclosed in a silken cocoon and are also found in dust.

The larvæ may also inhabit the human subject, and are said to feed upon the scurf of the hair.

Innumerable accounts of the Herculean strength of the common flea have been written by English, French, and German authors, so it is unnecessary to add more to this subject here. Perhaps the account given by Walckenaer, in his "Histoire Naturelle des Insectes," Aptères,* where he describes the military exercises gone through by thirty fleas, is one of the best. The enormous strength and power of leaping displayed by these somewhat obnoxious insects can be comprehended when we consider that if a lion had the same proportion of strength to the size of its body it could leap two-thirds of a mile!

Pulex canis, Dugès (= *P. serraticeps*, Gerv.).

The "Hundefloh" of the Germans. Resembles *P. irritans*, but is smaller ($\frac{4}{5}$ lin.) and paler in colour. Coxæ bristly; femora devoid of bristles and hair. Tibiæ thick. The legs generally shorter than in *irritans*.

The fifth and second tarsi the longest in the two front legs; the first and fifth, in the hind leg, as in *irritans*. The *fifth* being the longest in the front legs in this species; not the second, as in the common flea.

The unguis are large and broad, dark in colour, and fringed with black spines on both sides. Last tarsal joint armed with five spines on the under surface. Head small, compressed, ciliated with bristles; punctate behind. Eyes small and lateral. Mandibles long and slender, transparent, central rib well marked. Tongue same length as the mandibles. Maxillary palp, robust pilose, second joint from base the largest. Mentum small. There is a comb-like fringe on

* Vol. iii., p. 366, note.

the pro-thorax. Mr. Haliday first discovered the antennæ of this species. They are two-jointed, short and flat, the first joint having a bristle near its internal apex, and the other crowned with spines.

This species is common on the dog and fox, and most other members of the *Canidae*.

Pulex gallinæ, Bouché.

Deep black above, testaceous below. Differs from *irritans* in being smaller, more compact, and in the length of the antennæ, which are lanceolate, the last joint being thin. Maxillary palpi slender and filiform. Femora bare; tibiae and tarsi spinose.

There is a curious comb-like fringe to the pro-thorax.

This species is common on the domestic fowl, and especially in the nests. Hundreds may be got by putting the hand in the nest. It is also found on other birds, as the thrush, robin, and in the nests of the blackbird. Mr. Dale believes a species described by Westwood from Ceylon as *Sarcopsyllus galinaceus*, to be identical with the one just described.*

The larvae of *Gallinæ* are darker than those of the domestic flea, and are found in birds' nests.

P. gallinæ is also recorded from the nests of the house-martin and from those of the sand-martin, in the cracks in the clay. "Those from the nest of the sand-martin were darker than those from the house-martin, and they may be a distinct species."†

We have found *P. hirundinis* in the nests of the house-martin, but never *Gallinæ*, although repeated searches have been made. *P. hirundinis* does not seem to be given by Verrall; it nevertheless seems to be a perfectly distinct species. May not the *Gallinæ*, recorded above, be the same?

Pulex hirundinis, Sam, Curtis, and Walker.

Differs from *Gallinæ* by being testaceous, and by not being so elongated and having shorter antennæ. There is also a black band on the hinder part of the thorax.

Abdomen and legs setose. Antennæ four-jointed; the basal joint, having three or four long bristles attached to it, can be entirely withdrawn into the pits. Eyes small and lateral. Maxillary palpi slender, the top segments having a few hairs. Labial palpi setose at the tips. Joints of tarsus gradually decreasing from the first to fourth, the fifth being larger than the fourth, and with more bristles on each side.

This species may include *P. columbae* and *Fringillæ* of Walker,

* *Ent. Mo. Mag.*, vol. xxvi., p. 161.

† *Ibid.*, vol. xxvii., p. 51.

but, according to his descriptions, they are different. Those that we have examined from the pigeon seem to be slightly different from *Hirundinis*, being longer and darker and slightly different in the construction of the mouth parts.*

P. hirundinis infests swallows, pigeons, sparrows, and other small birds, especially in their nests.

The mouth parts have been figured by Curtis as long ago as 1836.†

Pulex sciurorum, Bouché.

Larger than the common flea, and more elongated and paler in colour. Length, $1\frac{1}{6}$ to $1\frac{1}{2}$ lin. Head bare; body smooth and shining. Antennæ short and light in colour, yellowish. Pro-thorax dark and ribbed; meso-thorax also bare. Legs devoid of hair and bristles as seen in most fleas. First and fifth joints of fore tarsi longest; the fourth the shortest. In the hind tarsi the first, second, and third, in succession, the fifth being larger than the fourth. Ungues straight and closely fitted together, resembling one claw.

This species seems to be exclusively parasitic on the common European squirrel (*Sciurus vulgaris*), and is met with all over Europe.

Pulex melis, Mk.

This is a large species, long and hairy. General hue, testaceous. Antennæ filiform, long, composed of four joints; the fourth joint longer than the third; the third smaller than the second; the second longer than the first. Legs setose. Abdomen hairy; four bristles near the tip. Joints of tarsus decrease in length from the first to the fourth. Length, $1\frac{1}{2}$ to 2 lin.

This species is parasitic on the badger (*Meles taxus*), and is found all over Europe.

Pulex erinacei, Bouché.

A large species infesting the hedgehog, with a curious fringe of small spines on the hind border of the meso-thorax, appearing like black ribs on the meta-thorax (?)

We have not seen this species ourselves.

Pulex gonicephalus, Tasch.

The "Kaninchenfloh" of the Germans. Described in Taschenburg's "Insectenkunde." Infesting the weasel, marten, and rabbit.

* Described in Walckenaer, "Aptères," vol. iii., p. 375, pl. 48, fig. 7, and in Walker.

† Curtis's "British Entomology," vol. vii., pl. 417.

This flea is described by Taschenberg as being short and thick, and yellowish-brown, easily recognisable by the blunt edge with which the vertex passes into the forehead ("leicht kenntlich an der stumpfen Kante, mit welcher der Scheitel in die Stirn übergeht"). On the under edge of the head stand out from the front to the antennal sockets, on each side, five to six black, blunt spines, and the pronotum also bears the same number on its posterior edge. The abdominal rings have each one row of hairs in their centres. The eye is equally distant from the top and bottom edge of the head; some bristles are observable in front and behind it. In the anterior legs the four first joints are equally short and thick, the fifth somewhat exceeds the third in length (?) "das fünfte etwa von der, Länge der drei vorangehenden"). In the middle pair, joints three and four like each other, short and thick, the first a little longer, second and fifth more slender, and second a little shorter than fifth; in posterior pair joints three and four are short and resemble each other, and together are as long as joint two or five, each of which is a third as long again as the first joint. Body length 2 mm.* It is found also on hares. The same as *P. leporis*.

Pulex fasciatus, Bosc. This resembles *Sciurorum*, but is longer and paler. The pro-thoracic comb has eighteen teeth. No black spines on the head. Found on the rat.

Genus 2.—*HYSTRICHOPSYLLA*, Tasch.

Head truncate in front; eyes wanting. Cheeks and clypeus densely spinose, and also some of the abdominal segments. The whole body furnished with extremely numerous bristles and hairs.

H. obtusiceps, Ritsema =
$$\begin{cases} Pulex talpæ, Bouché. \\ Pulex fasciatus, Lat. (?) \\ Ceratophyllus talpæ, Curtis. \end{cases}$$

General colour ferruginous and shiny; head also shiny; the clypeus covered by dark bristles, which hang down and cover the mouth. Thorax small and cylindrical; pro-thorax dark at the sides. Eyes pale, ovate. Antennæ ten-jointed; basal joint ovate; the remaining joints composed of rings, bristles on one side; on both sides of the basal joint. Maxillary palpi four-jointed, the basal joint longest. Abdomen compressed, each segment being furnished with dark bristles on the posterior margin. In the female the last segment is elongated on each side, forming two discs. The apex is marked by a number of bristles of large size.

* "Insecten-Kunde," vol. v., p. 132.

Legs ferruginous, somewhat darker than body. Coxæ notched near the posterior joint, on the four hind legs; smaller and not notched on the fore legs. Femora short and thick on four posterior legs, thin on fore legs, all having a few bristles. Tibiæ and tarsi with strong bristles, especially on the former on the posterior margin. Metatarsi long and thick, first and fifth tarsal joints being the longest. Length, about 1 in.

This is recorded by Curtis and by Walker as infesting the mole. Dale says: "It is quite certain that *Talpæ* is a misnomer, as it is not found on the mole."* He found this species in a field-mouse's nest. Curtis also mentions one similar to his *Talpæ* being given him, found on a rat. This species has been figured by Curtis.†

Genus 3.—TYPHLOPSYLLA, Tasch.

Body elongated and narrow. Head in many (specimens) very long; eyes wanting or rudimentary. On the under side of the head are found constantly chitinous bristles, the same on the pronotum, and in a number of species also on several abdominal segments (Tasch., "Die Flöhe," p. 86).

T. octactenus, Kolenati = *Ceratophyllus elongatus*, Curtis.

Ochreous, ferruginous, and brown in places; shining, elongated, and attenuated towards the head, which is bare. The antennæ are eight-jointed, pilose, sub-clavate; the first and second joints being large; the third joint is narrow; the remaining five form an ovate club. Maxillæ black; black bristles on the thorax and abdomen. Eight combs along the back. Abdomen attenuated in front, dilated at the apex; genital valves largely developed. Legs pale yellowish; tibiae and tarsi sparingly clothed with long dark hair; claws black.

This is the description given by Curtis of *C. elongatus*, which is parasitic on the yellow bat (*V. noctula*).

T. musculi, Dugès = *T. muris*, Curtis.

Dark yellowish-brown. Head covered by short dark hairs, with a few almost black bristles in parts. Body attenuated in front. Comb only on posterior margin of pronotum. Legs having very few hairs or bristles; femora bare and curved; tibiæ with black bristles; fore coxæ punctate, with black bristles. Four genal spines.

This species infests *Mus musculus*, *Agrarius*, *Decumanus*, *rattus*, and *Arvicola arvalis*.

* *Ent. Mo. Mag.*, vol. xxvi., p. 161.

† Curtis's "British Entomology," plate 114.

T. assimilis, Tasch.

With only three genal spines.

Infests *Sorex vulgaris*, *Mus sylvaticus*, *Arvicola riparia*, and *Talpa vulgaris*.

This species is recorded by Saunders,* but is not mentioned in Verrall's list.

T. gracilis, Tasch.

Body elongated, very slender, and light brown. Head above rectilinear; three spines not on the cheek, but on the suture dividing the antennary cavity from the front of the head. The spines are straight and directed backwards; the lowest is the shortest, conical, and blunted; the second longer and pointed, the longest uppermost, and springing from the front edge of the antennal pit, blunt and tooth-like; pronotum furnished with nine long bristles, and spines on each side. Abdominal bristles in one row only; the second row is represented by one or two bristles only, and are very small.

This is another British species, mentioned in Verrall's list.

Curtis also records a flea from the hare (*C. leporis*), and from the starling (*C. sturni*). *Leporis* appears to be the same as *gonocephalus*.

The *Palicidae* tabulate as follows:

1. *Pulex*: eyes distinct.

2. *Hystrichopsylla*: densely spinose cheeks and clypeus. No eyes, or eyes indistinct.

3. *Typhlopsylla*: no eyes, or eyes indistinct.

1. *Pulex*:

No pro-thoracic comb posteriorly, *irritans*.

Posterior comb present.

Head without black spines.

Proth. comb with 26 teeth or more, *Avium* or *gallinæ*.

“ “ “ 18 “ “ *Sciurorum*.

“ “ “ 3 “ on each side, *Erinacei*.

“ “ “ 18 “ *fasciatus*.

Head with black spines.

Epistome and cheeks with 6-7 black spines on each side, *Canis*=*felis*.

Post. margin of cheeks with 4 black spines, *Goniocephalus*=*Leporis*.

* *Ent. Mo. Mag.*, vol. xxvii., p. 170.

2. *Typhlopsylla* :

- 8 combs along the back, *octactenus*, Kol.
- 6 " " " " " *hexactenus*, Kol.
- Comb only on posterior margin of pronotum.
- 4 genal spines, *musculi*.
- 3 " *assimilis*.

Three spines on the suture dividing ant. cavity from the front of head, *gracilis*.

3. *Hystrichopsylla* :

Cheeks and clypeus densely spinose, *obtusiceps*.

The geographical distribution of the "fleas" seems to be world-wide, occurring from the Arctic regions to the tropics. They seem, however, to flourish best in warm climates, where they swarm in every room. Darwin gives a curious episode respecting fleas on reaching the mountainous country near Coquimbo. He says : "I enjoyed my night's rest here from a reason which will not be fully appreciated in England ; namely, the absence of fleas ! The rooms in Coquimbo swarm with them ; but they will not live here at the height of only three or four thousand feet."* This, he states, cannot be on account of the trifling diminution of temperature at that height. They occur just as plentifully in the mountain châlets of Switzerland also as in the warmer valleys.

There appear to be no records of fossil fleas, as far as I can make out. None seem to be recorded from fossil amber, as we might expect.

Modes of Destruction :

1. Careful sweeping of carpets, mats, and rugs upon which animals are in the habit of resting, and instantly burning the dust, thus stopping the development of the ova. If they are allowed to hatch, the small larvæ soon migrate into cracks and crevices, and are then difficult to dislodge.
2. Paraffin is found a good remedy for destroying the larvæ as well as dispersing the adults, and should be applied fairly strong to all cracks and crevices where dust has accumulated.
3. The leaves of the feverfew are also said to keep away fleas ; whether this is true or not I am unable to say.
4. The following method is taken from "Land and Water" :
"Take a few handfuls of fresh garden mint, and strew them about the rooms, particularly under the beds. This plan I adopted when on the Neilgherry Hills with perfect success."
5. For cleansing floors, etc., a solution of carbolic acid or paraffin

* "Voyage of the *Beagle*," Darwin, p. 344.

(the former hot) are suitable agents. There is, also, an old country method of a boiled concoction of laurel-leaves, poured over the floor when boiling. No doubt the boiling water and the prussic acid in the leaves may have some effect.

For animals, such as dogs, the same rule of cleanliness applies. If the kennels are kept well purified with insect-powder and carbolic acid, these insect pests soon disappear. In dogs very badly affected, a bath of gas-water, after having been sprinkled with insect-powder, is often very satisfactory, especially in long-coated dogs.

Literature on the Aphaniptera :

1. Annals of Nat. Hist., 1848. "The Common Flea." Westwood.
2. Annals of Soc. Entom. de France, 1872. "Metamorphoses de la Puce du Chat (*Pulex felis*)."
Dr. Al. Laboulbène.
3. Annals of Soc. Entom. de France, 1873. "Observations sur les Puces, en particulier sur les Larves des Puces du Chat et du Loir (*P. felis* et *P. fasciatus*)."
J. Kunckel.
4. "Die Flöhe," von Dr. O. Taschenberg. Halle, Max Niemeyer, 1880.
5. "Insekten-Kunde," von Dr. Taschenberg, p. 127.
6. Hist. Nat. des Insectes, Aptères, Walckenaer, vol. iii.
7. Insecta Britannica, Diptera, vol. iii. Walker.
8. British Entomology. Curtis.
9. Arcana Naturæ, tom. i. Leuwenhoeck.
10. Ann. Sci. Nat., 1832 and 1836. Dugès.
11. Nov. Act. Acad. Cæs. Nat. Curios., vol. xvii. Bouché.
12. Brasil. vorzugl. läst. Ins. (fig. 5), translated in Mag. Nat. Hist. vol. ix. Pohl and Kollar.
13. On the Affinities of the Aphaniptera. Nat. Hist. Re. Pro. iii., p. 9, 1856. A. H. Haliday.

NOTE 1.—The "Jigger." Mr. Newton, Vice-Consul at Loanda, informs us that the "Jigger" was not known on the W. coast of Africa before 1872, but that year the ship *Thomas Mitchell* went from Rio Janeiro to the port of Ambry, and the crew on arrival were suffering from "Jiggers." These were quickly communicated to the crews of the boats and introduced on shore, and in a short time everyone had them in Ambry. They have since gradually spread along the coast. Mr. Newton continues to tell us that he has seen many natives without toes and in a dreadful state from allowing the eggs to hatch and burst and the wound to fester. The "Jiggers" keep along the coast, and are seldom found in the interior. They generally attack the hands and feet, but have been observed in all parts of the body, and are chiefly found in *dry* and *sandy* places, not in the damp.

NOTE 2.—*P. erinacei*, p. 32, has a few bristles or spines on the prothorax (not mesothorax), but no fringe.

NOTE 3.—*P. gallinæ*, p. 31. Mr. G. C. Bignell, F.E.S., has kindly sent me some fleas from house-martins' nests. These are undoubtedly typical specimens of *P. gallinæ*, and differ from those taken by myself from swallows' nests in several points which will be given at the end of vol. i.

CHAPTER IV.

NEMATOCERA.

THE CECIDOMYIDÆ.

AFTER the short account of the *Pulicidæ*, we now pass on to the chief sections of the Diptera, and proceed to describe the more important families of each section, commencing with the *Nematocera*. The characters of the two sections of the sub-order *Orthorrhapha*, viz., the *Nematocera* and the *Brachycera*, are as follows :

*Nematocera.** This section has the antennæ composed of *more* than six joints, and the fundamental form is that of a thread. Two of the joints are known as the *scapus*, and the following those of the *flagellum*. The third joint, that is the first flagella joint, is never so distinguished as to render the succeeding joints accessories to it, the joints being formed in such a way that we cannot consider the flagellum as one joint, marked by annulations.

Palpi composed of four or five joints.

Brachycera. Antennæ short, three-jointed. The two joints of the *scapus* likewise separated. Third joint remarkably developed and has a peculiar anatomical structure, which is most probably for sensorial functions. The succeeding joints absent, or very few in number; when present they are in the form of a bristle. In some genera the first joint of the flagellum is not enlarged, then the following joints are more numerous, and most seem to be sensorial in function. These joints are so closely approximated that they can almost be considered as one joint, marked by annulations. The palpi are 1 to 2 jointed.

Although the above characters seem to sharply separate these two sections, they nevertheless are so closely connected by intermediate types, that some cannot be satisfactorily placed in either division.

The *Xylophagidæ*,† for instance, can be placed on the limits between both sections, and amongst the *Nematocera* the *Rhyphidæ* are nearly related to the *Brachycera*.

* *Vide* p. 18.

† *Vide* p. 20.

THE CECIDOMYIDÆ -

Cecidomyzidæ, Hal.
 Tipulariæ Gallicolæ, Meig.
 Cecidomynæ, Rond.
 Cecidomiites, Newm.
 Cecidomyzides, Zett.

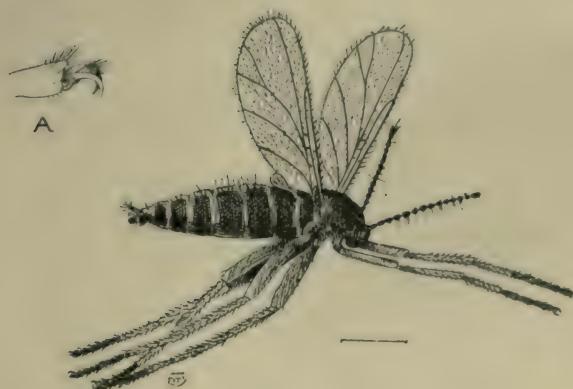


FIG. 6.—*Catacha latipes*. A, Ungues and pulvillus of *C. latipes*.

This is one of the most important families of the Nematocera,* and contains a very large number of extremely minute insects, characterized by the following points: "Eyes lunate, ocelli very often absent. Antennæ moniliform, composed of thirteen joints in ♀, 24 in ♂, at least, and ornamented with short verticillate hairs. Very few veins are present in the wings, which are often hairy. Thorax devoid of transverse sutures. Legs long, coxae short, femora elongated and thin, tibiae destitute of spurs."

Taschenberg † describes the Cecids generally as follows:

Extraordinarily small. Colours change in death. Head comparatively large, proboscis short, palpi generally four-jointed; rather large eyes, generally bare, ocelli absent in most species. Antennæ long, often very long, globular or cylindrical, depressed or stalked, articulations varying in number according to the sex. Thorax arched, scutellum small. Abdomen cylindrical, eight-ringed. Legs very slender, tibiae without spurs, tarsi small, with one pulvillus (Fig. 6, A). Wings large, broad, rounded in front, decreasing at the root, edged with hairs, often hairy at the surface. The radial, discoidal, and anal veins are wanting, so that there are only three to five veins. Sub-

* This family is included by Osten-Sacken in his *True Nematocera*.

† Taschenberg's "Praktische Insekten-Kunde," 1880.

costal and cubital often close together, postical often forked.* Between the cubital and postical is a vein-shaped fold. The little cross vein is long and often so crooked that it looks like the beginning of the cubital.

The cross vein often found between the discoidal and postical is wanting in the Cecids.



FIG. 7.—Balancer of a Cecid.

The "balancer," or "haltere," of the *Cecidomyiidae* (Fig. 7) : Lowne divides the "balancers" or halteres of flies into three portions, viz., the base (extremity which joins the body), pedicle (or stalk between the two extremities), and globe (distal extremity). The base contains four groups, each group composed of rows of vesicles (as Keller and Lubbock name them), the number of rows varying in various kinds of Diptera. The two upper rows or "ridges" of vesicles, viz., those nearest the pedicle, are generally arranged in the form of two half cylinders, and the lower rows form a hemisphere. The grooves between the rows bear curved hairs. Lowne thinks that the vesicles are contained in sacculi, and that there are bright "corpuscles of high refractive power" beneath them. In the blow-fly there are altogether nearly 1,000 vesicles in each halter. The globe contains large vesicles of fluid. The nerve of the halter divides into several branches in the base, and passing through the pedicle, ends in loops and nerve cells in the globe. The vesicles are supposed by Keller, Lubbock,† Lowne, and others, to be auditory rods, forming part of the hearing apparatus of Diptera. Lowne (who describes a similar structure in the sub-costal nervure of the blow-fly's wing, believed by him to serve a similar purpose) remarks that, being beautifully balanced by muscles, the halteres are not much affected by the vibrations of the body, and are, therefore, well-fitted for the development of auditory organs.

Owing to the extreme smallness of the halter in a Cecid (the object being almost invisible to the naked eye when detached from the insect), we have found it very difficult to discern the rows of vesicles

* 1st longitudinal vein = "subcostal."

2nd , , = "cubital."

3rd , , = "postical."

4th , , = "discoidal," etc.

† "Anatomy of the Blow-Fly," p. 96.

‡ "Senses of Insects," Sir J. Lubbock.

under the microscope, and impossible to count them. Only a rough sketch of the balancer is therefore given here, the bulb being the part which joins the body, and some groups and rows of vesicles being indicated in the narrower part.

The males are smaller than ♀, and their abdomens have knotty pincers (Fig. 8); the females have pointed projecting ovipositors.

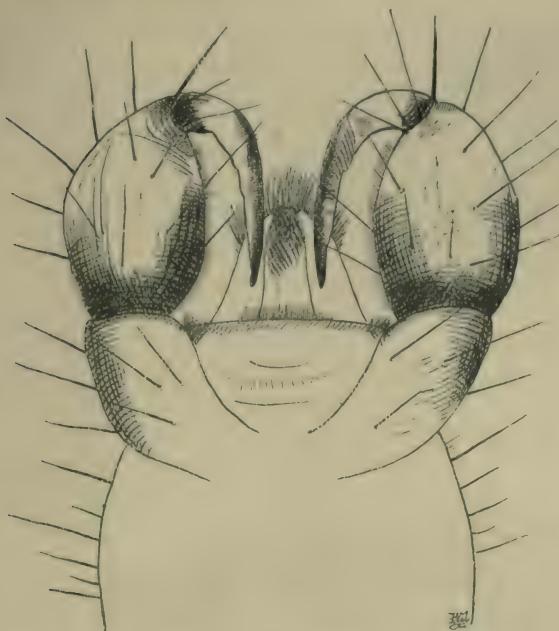


FIG. 8--♂ *Genitalia* of a *Cecid*.

Larvæ, fourteen-ringed, become pupæ within the larva skin, or are uncovered.*

These characters are sufficient to separate the Cecidomyidæ. The limits, however, between this family or "gall gnats," as they are popularly called, and the "Fungus gnats," or *Mycetophilidæ*, cannot be easily fixed, the genus *Zygoneura*, for instance, bridging over the two families, this genus showing combinations of characters found in both families; the coxae being far less elongated, and the spurs of the tibiae far shorter than in the *Mycetophilidæ*. Besides this, they have undoubtedly Cecid characters in the antennæ, which are moniliiform with verticillate hairs, a character never found in "fungus-

* Winnertz figures larvæ of *C. Urticæ* and *Tremulæ* (Lin. Ent.), Pl. I., 1 and 2.

gnats." But in spite of these Cecid characters, *Zygoneura* agrees closely with *Sciara*, which is a true Mycetophilid.

Notwithstanding these few exceptions, the *Cecidomyidae* are a well-defined family, and one that has a great number of extremely interesting points, both from an entomologist's and from an agriculturist's point of view, while the student of biology will also find much of great interest, such as the parthenogenetic development of the larvae.

The natural history of these minute insects has been studied in close connection with their classification. This is owing to the fact that one of the most important stages in their life-history is the formation of "galls," in this respect resembling the *Cynipidae*, a family of small hymenopterous insects, which attack plants in a similar way.

All the *Cecidomyidae* are small insects, and not easily identified. Their wings are covered by minute hairs and scales, which very easily rub off. They are most easily identified by studying the "galls" in which the larvae live, and for this reason we are so well acquainted with many of the life-histories of the family. There are certain species which do not produce gall formations, but live upon cereals. Of these we must particularly note the Hessian-fly (*C. destructor*) and the wheat-fly (*C. tritici*), which are so destructive to crops.

Perhaps no family of Diptera are so interesting as the one we are considering; not only are they interesting as perfect insects, but their larval stage is, if anything, of more importance, as in many cases it so well illustrates that curious phenomenon in the animal kingdom known as *parthenogenetic* development. It was first discovered and studied in these larvae by Wagner,* and has continually called forth a great deal of attention at the hands of embryologists. It takes place as follows: The female places her eggs under the bark of a tree, where they first develop into ordinary larvae, but internally curious changes take place. The ovaries become fully developed and bud off eggs;† these eggs live upon the visceral mass, and soon hatch into secondary larvae, which again give rise to another generation, and so on until as many as five generations of larvae may be seen in the old larval skin. In the following summer a metamorphosis takes place and the sexual generation appears. There are other interesting cases of parthenogenesis in the Diptera, but none so interesting as those of the *Cecidomyia*.

* *Zeitschr. f. Wiss. Zool.*, T. xiii., 1863; also Schneider, *Zool. Beitrage*, i. (3), 1885, p. 272; and Mecznikow, *Z. n. Z.*, xvi., 1866, p. 407.

† = *Pædogenesis* (*i.e.*, the production of ova by the immature animal, and is in the *insecta* always parthenogenetic).

The explanation of this alternation of asexual and sexual generations is the same as that given to the phenomena observable in the Aphides.

This parthenogenetic development has a very limited range in the animal kingdom, being found only in Arthropods and Rotifers. It has no doubt been derived in a secondary way from sexual reproduction. Some most remarkable cases are found in insects such as bees and saw-flies, in which ♂'s are produced without any fertilization, contrary to the usual rule, where ♀'s are produced when no fertilization has taken place, and these give rise to further generations of females. Eventually through a change of climatic conditions and food both males and females are produced.

The existence of sexual with asexual parthenogenetic reproduction has led to that remarkable phenomenon in the animal kingdom called "alternation of generations," so typically displayed in the Coelenterates and Annelids. These furnish us with the most simple forms of "alternation of generations," viz., a sexual form giving rise to an asexual form which, by a process of budding, gives rise to sexual forms like the one from which it started. This form of alternation is easily understood. The ancestors of the species originally produced themselves sexually and by budding at the same time, but most likely at different seasons of the year. By degrees the two modes of reproduction became confined to separate individuals, and then gradually the dissimilarity in habits caused their structure to become considerably modified; and thus gradually a complete alternation of generations became established.

A closely-allied mode to the one above (sexual and budding) is seen in the case of those animals where sexual reproduction alternates with parthenogenetic reproduction, or with larvae that may produce sexually or parthenogenetically. The Aphides may be taken as an example of this. In this case the ova develop parthenogenetically in the oviduct of the female, and as long as warm weather and plenty of food remain this mode of reproduction continues, but as soon as these conditions fail, sexual (♂ and ♀) individuals appear. We may assume here the capacity of the females for producing parthenogenetic young without the intervention of the male element has been found advantageous, and has been taken hold of and moulded by natural selection and has led to the permanent production of viviparous parthenogenetic young, which only change to male and female forms at the cessation of favourable conditions. The same explanation applies to the Cecidomyia larvae as mentioned above.

The egg of the *Cecidomyia* is rounded at each end and slightly elongated, yellowish to white in colour. The period of hatching is extremely variable, some ova taking weeks to develop; some can, by artificial warmth, be made to hatch in a few hours.

The larva.—The food of the larva is mostly vegetable; some live on decayed wood, others under the bark of trees, and some few are said to be saprophytic, but most are true vegetable feeders, living on the soft parts of leaves and stems of plants.

A few have also been recorded from fungi, and some from pinecones (*C. strobi*). They each have definite plants to live upon, and are seldom found on widely-different genera. There are, of course, exceptions to this rule, as shown by Winnertz, who points out that *C. sisymbrii* inhabits a gall on *Berberis vulgaris* in May and June, and a gall on *Nasturtium sylvestre* from June to November.

Again, there are larvae that live as guests* in the galls of other species. It is a general rule to find several larvae in company with one another. (*Diplosis* with *Hylesinus* and *Apion* in the stems of *Sarrothrium scorpiarium*.)

The larvae mostly live inside the vegetable tissue and produce the so-called galls, destroying, stunting and deforming the tissues of the plants. There are also some that live outside the plants (as *Diplosis ceonatis*); and others, as the Hessian-fly and Wheat Midge, that live in the axils of leaves and amongst the florets of wheat.

As to the various deformations produced by these larvae, it is not possible to enter here into all the numerous varieties produced. They vary from rounded protuberances attached by stalks to the stems of plants to rugosities and swellings on leaf and stem, arresting the growth and often destroying the reproductive faculties of the plant by forming gall-like masses in the flower-heads.

On leaving the egg-membrane the larvae (Fig. 9) are colourless and transparent, the alimentary canal being seen through the body-wall, often assuming a green appearance, derived from the vegetable food it has been consuming. The whole larva, as it advances in age, becomes opaque, and assumes a reddish appearance, or sometimes a yellowish colour.

One striking peculiarity of these larvae is the number of joints. Between the head and first thoracic there is placed a supernumerary joint; to which segment this belongs we cannot say; it might belong to either the head or the thorax. Thus we have in these larvae fourteen joints instead of the normal number, thirteen.

The head and mouth parts do not seem to be properly under-

* Often called "inquilines," from the Latin *inquilinus*, a guest, or sojourner.

stood. The horny parts consist of a ring with two backwardly-projecting processes, with a soft and fleshy labium passing through it. There are also two 2-jointed appendages above, the palpi of Ratzburg and the antennæ of Osten-Sacken.

On the under side of the larvæ we at once notice a curious, horny appendage. This is called in America the "breast-bone," and in England the "anchor-process" (Fig. 10). It is situated at the junction of the supernumerary and first thoracic segment. This appendage varies in the different species; the base is buried in the first thoracic segment, the elongated stem of the process ends in various forms, some being toothed and some serrated.

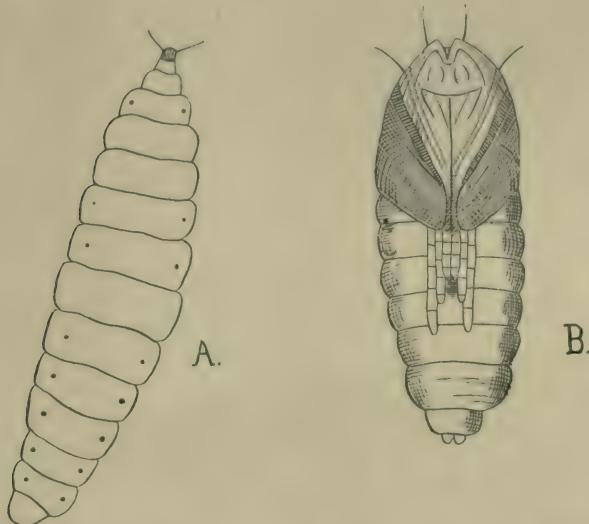


FIG. 9.—*Larva* (A) and *Pupa* (B) of a *Cecidomyia*, greatly enlarged (about 18 times).

What is this process and what is its function? Neither of these questions can be satisfactorily answered. It is considered by some to be homologous to the pseudopods of *Chironomous* larvæ. Osten-Sacken considers that the fourteenth segment is part of the head. This anchor-process, then, might be taken for the mentum, in analogy to the horny mentum of *Tipularæ* larvæ.

Miss Ormerod considers that it is used as a scraper or digger to assist in acquiring the food from the stem.*

The stigmata, which are horny projections, are normal in number

* See also Mr. Enock's opinion, p. 50, Tr. Ent. Soc., 1891.

and position. One pair on the first thoracic, and eight on the first eight abdominal segments, the last segment being devoid of any stigmatic opening. In *C. pini* the last segment was considered to be stigmate, but this is not the case, the last segment being hidden under the eighth.

The larvæ may be hairy or armed with bristles, and may have fleshy caruncles along the back, or may be entirely smooth. The last segment may be armed with two curved processes, which are used in leaping, several of these larvæ being noted for their saltatorial habits (*C. nigra*).^{*} They are often very active, and this has been particularly noticed in rainy weather, and also during and after a thunderstorm.

The larvæ may also have pseudopods on their ventral surface. They do not seem to require much nourishment, moisture being essential to them. They produce the galls through some irritating function



FIG. 10.—The Anchor Process of (1) Hessian Fly (*C. destructor*) and (2) of Wheat Midge (*D. tritici*), (from Miss Ormerod's manual).

peculiar to them, causing an abnormal flow of sap. Some species are seen, however, to be extremely voracious. They are generally found in companies; as many as eight or ten may often be got from the galled flower spikes in which many live; on the other hand, single larvæ only may be found, as in certain willow galls (*C. clausilia* on *Salix alba*).

There are certain larvæ that live as "guests" in the galls of other species; whether these live upon the excreta of their companions or upon the sap is not definitely known. The same applies to species that live under bark; they may live upon the excrements of other insects.

M. Vallot mentions some that live upon *Acari*, sucking their juices, and found under the leaves of *Chelidonium majus*. At the close of larval life the maggots may leave the galls and pupate in the earth; but some species remain and pass the dormant stage in their old homes. The lives of the maggots vary in length. The larva of the Hessian-fly (*C. destructor*), according to Dr. Lindeman, lives twenty-eight days, and then changes at the spot where it fed to a

* This is a character of the sub-genus *Diplosis*, to which *C. nigra* most probably belongs.

brown flat chrysalis, known as a "flax-seed." The larvæ of Cecids do not undergo many moults, and eventually form a cocoon.

The history of this cocoon formation, if correct, is curious. Winternert absolutely denies that this cocoon is spun: he says it is generally formed by an excretion and not by threads. He observed one larva that in twenty-four hours was surrounded by a halo of white thread-like particles, resembling the spicules of crystals, the larva remaining motionless the whole time. There are often no signs of a thread in these cocoons, which are formed in a few days. Others have resinous cocoons, and some spin undoubtedly a silken thread. The larval skin is not always shed during transformation. This change from the larval to pupal state is marked by a change of colour in the maggot, the anterior segment at the same time becoming distended, and by degrees the rudiments of the wings, legs, etc., become developed, and eventually the full pupal state is reached.

The pupæ (Fig. 9) of the *Cecidomyidæ* resemble in some respects those of *Sciara*, and are usually brownish flattened bodies of small size, resembling seeds. The bases of the antennæ are often produced into points, resembling horns. Behind these horns bristle-like projections may be seen in most pupæ—one pair on the head, and another on the thorax. Spinose processes may also be developed on the abdominal segments, all these processes helping the insect to work its way out of the gall or earth at the time of emergence.

The length of pupation is very variable, warmth greatly hastening the development. Under unfavourable conditions the pupæ may remain unhatched until the next year. Those of the Hessian-fly may be retarded by cold, but are not killed by a low temperature; dampness is essential to their hatching, a dry cold being injurious to the "flax-seeds."

Mention has been made of the injurious nature of the *Cecidomyidæ*. Of this there is no doubt; they, nevertheless, are beneficial as well as injurious. By their means a great many plants are fertilized; owing to their small size they can enter plants that very few insects can enter.

No better example of the fertilization of a plant can be taken than that of *Aristolochia clematis*, which is largely done by *Cecidomyidæ*. I have myself seen as many as five Cecids in a single blossom of this plant; one, however, is the general rule.

Fertilization takes place in the following way: This plant, which is a protogynous dichogamous plant, belongs to the family *Aristolochiaceæ*, and is widely spread over the globe, several species of the

genus *Aristolochia* being cultivated in England, and one, *A. clematis*, which is a European species, has been found occasionally wild, but is not an indigenous form. Few plants outside the *Orchidaceæ* have become so modified for fertilization by insects as the one in question. The flowers are all brownish-green, contrary to what we should expect, as we are told in Darwin's "Origin of Species" "that flowers have been rendered conspicuous in contrast with the green leaves and in consequence at the same time beautiful, so that they may be easily observed by insects." And likewise that "if insects had not been developed on the face of the earth, our plants would not have been decked with beautiful flowers."

In this *Aristolochia* we have a decidedly inconspicuous flower, not only visited by insects, but having assumed most curious adaptations to ensure fertilization. It is strange that this family, which calls in the aid of insects more than most plants, should not have developed a more conspicuously coloured blossom to attract them during the time it has been forming those complicated habits and structures relating to fertilization!

Each of these greenish blossoms commences with an expanded lip. This passes into a funnel or throat (A), which is lined by hairs, so placed that they allow the entrance of an insect, but not its exit. This long funnel opens into a flask-shaped enlargement (B), in which are placed the generative organs. This cavity is also lined by hairs, especially at the base, around the anthers. The stigmas (♀) are placed above the anthers (♂), and curve over them, the anthers being surrounded by the hairs of the flask.

Fertilization takes place in the following way: The *Cecidomyia* enters the throat and passes down it, the hairs being placed so as to allow its free passage. As soon as it enters the flask it crawls about until its back, which is laden with pollen, comes in contact with the stigma, and thus fertilizes them; upon this taking place they spring up and assume an erect position. At the same time the hairs of the flask collapse and the anthers dehisce. The insect then crawling down, gets the pollen upon its back. While all this has been taking place the hairs of the funnel have withered up, and the *Cecid* or other insect, laden with fresh pollen, flies away to another blossom to repeat its experiences. But this is not all; as soon as the insects are free from the fertilized flower, the lip of the corolla bends over the entrance to the blossom, and thus effectually stops another fly from entering on a useless mission. The whole pedicel assumes a bent appearance, while the unfertilized ones are erect.

This is, perhaps, one of the most curious adaptations that a plant

has undergone for fertilization by insects, and has called forth a great deal of attention. The figure below shows the modifications.

The distribution of the *Cecidomyidæ* in space seems to be very great; most regions of the globe furnishing examples of this family. They seem to extend into the Arctic Circle, but are more abundant as we approach warmer climes.

Their distribution in time is limited, as far as we know, the tertiary ambers alone yielding their remains. From these, two extinct genera, *Lithomyza* and *Monodiciana*, Lw., have been described. The former belongs to the *Anaretina*, and the latter to the *Cecidomyina*. About twenty-three species in all have been described, amongst the sub-genera *Epidosis*,* *Dirhiza*, *Diplosis*, *Cecidomyia*, and *Asynapta*, some from America and some from Europe. *Lasioptera* has also been found in a fossil state in Wyoming. Their small size and fragile nature would naturally hinder their preservation.

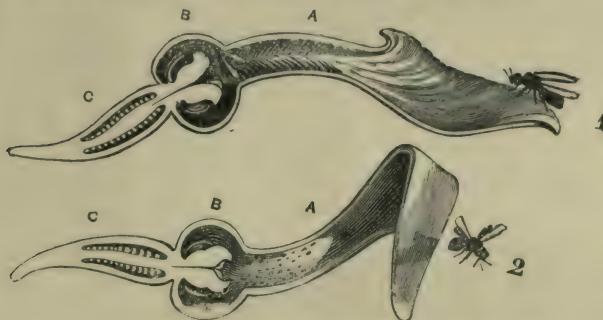


FIG. 11.—*Aristolochia clematis*, showing method of fertilization. 1. Unfertilized blossom. 2. Fertilized. A. Funnel. B. The flask with generative organs. C. The ovary.

The classification of the *Cecidomyidæ* is as follows. They can be divided, according to Loew, into two sub-families :

A. *Cecidomyina* = *Cecidomyinæ*, Rd.

Three or four longitudinal veins on wings, the last two often coalescing at the beginning of their course, forming a fork. Ocelli absent.

B. *Anaretina* = *Lestreminæ*, Rd.

Has a supplementary vein between the second and third of the *Cecidomyina*. This additional vein is furcate. Ocelli are present in most of this group.†

* "Bernstein-Fauna," p. 32 Loew, descriptions of *C. (Epidosis) incompleta* and *C. minutissima*.

† *Cecidogona* has no ocelli.

He makes three genera in A ; viz., (i.) *Cecidomyia*, (ii.) *Spaniocera*, and (iii.) *Lasioptera*. The first he divides into several sub-genera.

(i.) *Cecidomyia*.*

Antennæ long and moniliform, or cylindrical ; generally verticillate, 13-36 joints. Wings always very hairy, and have densely pubescent margins. Three or four longitudinal veins. There are two types of wings. In the first type the third vein is forked, thus representing the third and fourth veins, which have united for most of their length. In some rare cases this fork may become obliterated. In the second type of wing the four veins are separate and simple. We must note in these insects a curious longitudinal fold between the second and third longitudinal veins, present in most *Cecidomyiidae*.

(ii.) *Spaniocera*, Wtz. = *Brachyneura*, Rd.

Antennæ filiform, having no verticils, and composed of thirteen joints. Wings covered by scaly hairs. There are three longitudinal simple veins, the first running parallel to and close to the costa. The other two widely separate (Fig. 9A).

(iii.) *Lasioptera*, Mg. = *Lasiopteryx*, Steph.

Antennæ composed of 16-26 joints, each joint being sub-globular, with short verticils. The three longitudinal veins not so easily seen as in the above genus ; the first and second run close together, and near the costa. There is a large space between the second and third vein (Fig. 10A). Proboscis short.

The following is a short description of the sub-genera of *Cecidomyia* :

$$\text{Cecidomyia, Lw.} = \begin{cases} \text{Dasyneura, Rd.} \\ \text{Rhabdophaga, Westw.} \end{cases}$$

Same number of joints in the ♂ antenna as in the ♀. The joints may be pedicelled or sessile. The second longitudinal vein reaches the margin of the wing before its tip (Fig. 1A).

$$\text{Diplosis, Lw.} = \begin{cases} \text{Phytophaga, Rd.} \\ \text{Bremia, Rd.} \end{cases}$$

The antenna of ♂ = 26 to 27 joints ; that of the ♀ = 14 to 15. The joints are pedicelled. The second longitudinal vein reaches the margin beyond the tip. The joints of the antennæ of the ♂ double the number of those of ♀ (Fig. 2A).

* As far as I can make out, there seems to be a great division of opinion as to what the genus *Cecidomyia* is to mean ; Meigen, Latreille, Macquart, Zetterstedt, and Walker, holding one opinion ; Loew, Rondani, Westwood, Winnertz, O.-Sacken and Schiner, another. Taschenberg describes the genus as having sub-costal and cubital veins plainly separable ; postical vein forked.

Hormomyia, Lw. = *Angelinia*, Rd.

This sub-genus is distinguished by the gibbose thorax, which is often drawn over the head. The second longitudinal vein ends as in the preceding sub-genus. Wings without lustre.

Asphondylia, Lw. = { *Cylindrocera*, Lioy.
 Phyllophaga, Rd.

Antennæ with short hairs of equal length; joints cylindrical and sessile; no verticils. Same number of joints in ♂ and ♀. Second longitudinal vein reaches the margin of the wing, beyond its tip. Wings shiny.

Dirhiza, Lw.

Joints of antennæ sessile in both sexes. Second longitudinal vein hardly undulating before the cross-vein.

Epidosis, Lw. = *Porricondyla*, Rd.

Joints of antennæ pedicelled. Second longitudinal vein is sinose before the cross-vein. The cross-vein runs obliquely, commencing at the root of the first longitudinal vein in the last two sub-genera (Fig. 3A). In the others the cross-vein commences in the middle of the first longitudinal.

Asynapta, Lw. = *Winnetzia*, Rd.

Has four distinct longitudinal veins—all other sub-genera having three—the last being divided. Reputed British (Fig. 4A).

B. The second section is not satisfactorily classified. Loew considers the members of this section as forming a sub-section of the *Cecidomyidae*. Winnertz isolates them as a separate and distinct family between the Cecids and the Mycetophilids. Brauer places most in the *Cecidomyidae* and some in the *Mycetophilidae* (*Zygoneura*).

The following are the more important genera of this section :

Catocha, Hal. = *Macrostyla*, Wtz.

Ocelli present. Wings hairy. Third longitudinal vein forked, the upper branch forming a single smooth curve. The ♂ has verticillate antennæ, composed of sixteen pedicelled joints. ♀ antennæ ten-jointed, joints moniliform (Fig. 5A).

Campylomyza, Meig. = { *Campylomyia*, Z.H.
 Neurolyga, Rd.

Ocelli present. Wings hairy. Fourth longitudinal vein forked. Antennæ 11-20 joints, moniliform in ♂, with pedicelled joints. Sub-moniliform, with sessile joints in ♀ (Fig. 6A).

Lestremia, Macq. = { *Mimosciara*, Rd.
Yposataea, Rd.

Ocelli wanting. Wings pubescent. Antennæ moniliform in ♂, sub-moniliform in ♀, 16 joints. First longitudinal being short, third forked (Fig. 7A).

Colpodia, Wtz. One species is reputed as British. The second longitudinal vein forms a curve before the cross-vein, and joins the margin beyond the tip of the wing (Fig. 8A).

Cecidogna, Lw., antennæ 11-jointed;* *Micromyia*, Rd., is another genus found in Britain, and given in Bergenstamm and Löw's work.

Zygoneura, which shows certain affinities to the *Cecidomyidae* mentioned before, and also to *Sciara*, one of the *Mycetophilidae*, is now included in the latter family; but is no doubt a transitional form between the two. *Anarete* is now placed in the *Bibionidae*.

The following are the genera and sub-genera found in England, the names being those used by Verrall and in Bergenstamm and Löw's classification†: *Lasioptera*, Mg.; *Cecidomyia*, Mg.; *Asphondylia*, Lw.; *Diplosis*, Lw.; *Hormomyia*, Lw.; *Dirrhiza*, Lw.; *Epidosis*, Lw.; *Winnetzia*, Rd.; *Campylomyza*, Mg.; *Micromyia*, Rd.; *Catocha*, Hal.; *Lestremia*, Mcq.‡ Most of these are considered sub-genera of *Cecidomyia* by Loew; by others as true genera. By far the most important is *Cecidomyia proper*, which contains as many as fifty species indigenous to Britain,§ and amongst these by far the most interesting and important is the Hessian-fly (*C. destructor*), which we now proceed to describe, with other species of this sub-genus.

SUB-GENUS.—*Cecidomyia*, Lw. = { *Dasyneura*, Rd.
Rhabdophaga, Westw.

Cecidomyia destructor, Say (the Hessian-Fly).

The egg of the Hessian-fly, which is small and cylindrical, is described by some as being rounded at each end, by others as being pointed at each end,|| pale-orange colour at first, with reddish dots, becoming darker later and transparent the third day; about .02 mm. long by .008 broad. The larvae emerge on the fourth day. According to Mr. Enock,¶ a female will lay from 100 to 150 eggs; others say as many as 280. They are laid on many separate plants of

* This is now merged into the sub-genus *Lestremia*. *Diomyza*, *Clinoryncha*, *Heteropeza* and *Tritozyga* are other foreign genera.

† Synopsis Cecidomyidarium, 1876, J. E. von Bergenstamm and Paul Löw.

‡ The following is a reputed British genus: *Colpodia*.

§ Ninety or more, if we include reputed and doubtful records.

|| "Hessian-Fly Report of Department of Agriculture, U.S.A.," p. 208, 1880-82.

¶ Trans. Ent. Soc. of London, June, 1891.

wheat or barley, about eight in a patch, glued together by a sticky fluid. The greater number are deposited on the latest-developed leaves. The eggs are laid with the head end downwards, so that when the larvæ are hatched they are prepared to crawl down the leaves and stem, and to establish themselves within the leafy sheath, generally at the second joint above the ground.

The *larva* is short, stout, cylindrical, and soft-bodied; about 2 mm. long when young, increasing to about 3 mm. There are fourteen segments, and indications of prehensile feet at the anal end. When first hatched the larvæ are transparent, showing the alimentary canal through the extremely thin body wall, often green in colour, owing to the colouring matter of plants. They change colour when pupating.

The larva, when it has passed its feeding stage, develops a forked appendage, a horny short stem with two little projections, situated close to the head on the under surface of the second segment—the “anchor-process.”

In the case of the fly now under consideration, Mr. Enock has made the notable discovery that the larva, after it has finished feeding on the juices of the stem, with head placed downwards and inwards, turns itself completely round in its third stage, bringing its head upwards, anchor-process outwards, and that it uses the anchor-process to perform this feat.

This turning movement takes place within the “*puparium*,” as the hard case, or skin, is called, which gradually forms itself around the larva, in its second stage, after the first, or feeding stage, is passed.

This case is chestnut brown, and in size, shape and colour resembles a small flax-seed, so much so that this stage in the life-history of the fly is often called the “flax-seed stage.” At first the puparia are smooth, but after a few days they become marked by longitudinal striations. There are also transverse markings on these “flax-seeds,” showing the old segmentation of the larval body.

The ♂ puparium is narrower and paler than the ♀. The “flax-seed” stage may only last five or six weeks, or the fly may remain in this state throughout the winter or longer. (The time of emergence greatly depends upon climatic conditions, cold greatly retarding their development.)

The larva then works its way out of the puparium, casts its skin, and gradually changes into a true pupa. The *true pupa* is at first white, then pink, and becomes darker by degrees. It is oval, with rounded ends, the thoracic portion narrower than abdominal, limbs and body before emerging enveloped in separate cases. The pupæ

have the power of climbing up between the leaf-sheath and stem until they find an opening through which the imago can emerge.

A hard, sharp beak takes the place of the anchor-process, often used by the pupæ for cutting an opening through the leaf-sheath. The fly breaks the pupal skin and emerges at the end of twelve or thirteen days.

The Perfect Insect.—♀ Larger than the male. Length 3 mm. Eyes brownish-black; front of head black, and clothed with dark, long hairs. Palpi yellowish, composed of four joints, partly covered by minute black scales, entirely covering the terminal joint. Antennæ yellowish-brown to almost black, composed of seventeen joints, with short, black verticillate hairs.* The first two joints (basal joints) very thick; the first joint is cup-shaped, the second globular, the next smooth, cylindrical and elongated, gradually becoming smaller and terminating in a long, tapering point, longer than any of the preceding.

The proboscis is minute and rose-coloured. Thorax black, with gray tints in certain lights, white hairs on the sides, and also scattered on the central region.

Scutellum black, hairy. Halteres yellowish-pink, with occasional black scales. There is also a light-red line running from the neck to the base of the wing along the side of the thorax.

The abdomen is pinkish, or yellowish-brown, and is composed of eight segments. The first segment is nearly black, the remainder are marked by a large, square, black spot on each side. These black markings nearly unite on the seventh and eighth segments. The last two segments have a curious V-shaped marking, with two small lines, one on each side of it, and placed on a somewhat darker area than the yellowish colour of the segments.† The ventral surface is marked also by a line of black spots running down the centre. The oviduct is pale reddish-yellow, brownish at the tip, and composed of three joints. The last is pointed, and *without* lamellæ.

Legs pink to light red, clothed by black, scale-like hairs. Trochanters black, coxae brown, other joints yellowish-white.

Wings pink at the base, clothed by black hairs. The second longitudinal vein runs nearly straight, and then bends down and reaches the margin above the apex.

♂ Smaller and more elongated than the female, 2 mm. in length. The antennæ are composed of seventeen joints, as in the ♀; they

* Enock describes the hairs as red.

† First discovered by Miss Ormerod. Dr. Meade, in his description, say she did not observe this V-shaped mark.

are pedunculated, but longer than in the female. The terminal joint no longer than the others.

Hair on the scutellum is also different to the female, being white or gray.

Abdomen black, pink at the end, marked in the same way as in the female, but the black spots have united, owing to the thinness and elongation of the body.

A pink line is seen down the centre of the dorsal segments, and often a streak across each segment at its edge. The last segment is pink, and bears a pair of claspers of a brown colour ; between these claspers are situated the generative organs.*

Legs lighter than in the female.

Wings not so dark as the female, and longer in proportion to the size of the body.

The colours vary as the insects grow ; by some observers they are said to possess a reddish tinge when hatched (Enock).

Miss Ormerod saw the changes taking place as described by Wagner : "from a golden-brown, through the shades of mulberry with transverse black bands above on the first six segments of the abdomen, on to the general brown tints of the abdomen," etc.†

Mr. Enock finds the ♀ flies shy and retiring, hiding themselves under leaves and in holes in the ground, and resting on the earth, where their dark colour protects them. The first brood appears in August or beginning of September, and the second towards the end of April or May. Egg-laying continues through May and June. The eggs are laid either on wheat or barley ; oats at present not being attacked by this fly. Rye is, however, subject to the injurious attacks of this most important insect pest.

At present we are not aware that it attacks root crops in any way, nor pulse, such as beans, peas and tares.

Couch grass (*Triticum repens*) suffers largely from the Hessian-fly ; in Russia whole districts have been destroyed ; it is also known to attack "Timothy grass" (*Phleum pratense*) ; and at present, as far as we can tell, many more may be attacked in a similar way. Agriculturists should note this, as thick, grassy hedges, etc., near corn-fields may form nurseries for the Hessian-flies to develop. It also shows how beneficial burning stubble is in destroying this pest.

The ova are placed by the female a little above a node or joint of the wheat or barley stem. Dr. Griffiths says, in his manual of "Diseases of Crops," that the larvæ establish themselves "just

* *Entomologist*, 1887, p. 172. Fig. of male genital organs.—Meade.

† "Life-History of Hessian-Fly in Britain." *Entomologist*, 1887, p. 9.

above the second joint." This seems to be generally the case, but it is not at all uncommon to find them as high as the fourth joint, and as low as the first. They never are present in the ear. The "ribbon-footed corn-fly" (*Chlorops tenuiopus*) feeds in the ears of corn, and has very often been mistaken for the maggot of the Hessian-fly.

The attack of this insect is easily seen in a field of wheat, the straw bending down just above the abode of the maggot or maggots, for there may be several in very bad attacks at one point. It is not unusual to find a gall, or swelling, above the infested part.

The larvæ living on the juices of the plant weaken the stem, and although the ear and upper part of the straw may become stunted, the infested part becomes so weak that the upper part with the ear bends down, as if beaten down by rain and wind, thus doing immense damage to the crops. Hundreds of acres of wheat and barley are destroyed in this way in America, but at present we have not suffered much from its ravages, the loss in infested areas in England being from one to twelve bushels per acre.

This insect, which is two-brooded in America, has only one brood in England, and so here we are only subject to one attack. Young autumn-sown wheat, which is so much devastated on the American continent, is free from the attack here. This second form of attack is very different to the former. The maggot, which has developed from the autumn brood, lies just above the root, at the surface, and before assuming the "flax-seed" state it comes to lie between the leaves and the stalk. This second form of attack may be known by the dark colour of the leaves, their great breadth, and the absence of the central leaf. The whole wheat plant becomes stunted and rank-growing. The first brood appears in May and June, the second in August and September. According to Professor Riley the Hessian-fly "is very injurious only under conditions where two annual generations are pretty uniformly produced; and he is satisfied that in England, as a rule, only one generation will be produced."* The same entomologist, in "Insect Life," says that "there is very little danger of any such injury in England as is suffered in America and in portions of Continental Europe." Whether this is correct time will show; certainly the climatic conditions of our island are favourable to its increase.

The distribution of *C. destructor* is very wide; in America it extends from the Atlantic to Kansas and from the Gulf of Mexico to the St. Lawrence, doing an immense amount of damage. It was known

* Griffiths' "Diseases of Crops," p. 114.

in 1776 in America, and was said to have been imported by the Hessian troops, but this is most improbable. On the American continent it has flourished far more than in Europe, where it was first detected in 1834 in the Island of Minorca. According to Dr. Lindeman* it appeared in Russia in 1880.

It is found also in Germany, Austria-Hungary, France, Italy, and Sweden.

In England its first recorded occurrence was in 1886,† when in July of that year "flax-seed" puparia were sent to Miss Ormerod from Hertford. Since then the attack has been shown to range from Cromarty to the Moray Firth and down the east coast of England to Kent. In Scotland it has been discovered in Lothian, Perthshire, Haddington, and Berwickshire; attacks have also been recorded from Northumberland. As we pass in a southerly direction the attack widens out. Lincolnshire, Cambridgeshire, Huntingdonshire, Bedfordshire, and in some places in Northamptonshire it has been prolific. In Hertfordshire and some of the eastern counties very heavy attacks have also been recorded.

In Hampshire it has appeared at Petersfield and Lymington; at Goring Heath, in Oxfordshire; at Salisbury, and in Kent and Surrey. This is a somewhat curious distribution, it seems, to keep to the sea-coast as much as possible. Perhaps Cambridgeshire and Lincolnshire have suffered from the worst attacks.

In Ireland it has not yet appeared, and not farther north in Scotland than Cromarty, no records coming from Caithness or Orkney.

This fly is subject to a number of parasites, and by their study we can safely assume that the Hessian-fly was imported into England from Russia, or is at least of European origin. The study of these parasites has been ably worked out by Lindeman‡ and Riley.§ The latter entomologist expressed an opinion that the parasites in England would be shown to be of Russian or European origin, and such is the case.

The following are Russian parasites :

Merisus intermedius, *Tetrastichius Riileyi*, *Eupelmus karschii*, *Platy-*

* Bulletin de la Société Impériale des Naturalistes de Moscow, 1887.

† "Hessian-Fly in Britain: Life-History." *Entomologist*, 1887. Mr. Verrall does not consider the Hessian-fly a recent introduction, but had probably been here for a great number of years.—Prof. Riley considers that it has been recently introduced. It was not recorded by Banks, Curtis, Westwood, or Kirby, and by no economic entomologists—*vide Ent.*, 1887, p. 327—but noticed by the founder at least eleven years ago, in the February number, 1876.

‡ *Die Pteromalion der Hessenfliege von Prof. Lindeman.* Moscow, 1887.

§ *Proc. of U.S.A. National Museum*, 1885 (Parasites of the Hessian-Fly).

gaster minutus,* *Semistellus nigripes*, *Eurysapus saltatus*, *Platygaster*, sp. ?

Four of these Dr. Lindeman found in a collection sent him by Miss Ormerod, viz., *S. nigripes*, *T. Rileyi*, *M. intermedius*, *P. minutus*. There was also a species which agreed with Riley's description of the American *Mersius destructor*, Say.† But this is also found as *Ceraphon destructor* in Germany, as mentioned in Kollar and Kaltenbach's works. From this we see that our attack has been derived from some European source, most likely Russia.

Careful investigations on imported straw on the east coast seem to show that that was not the mode of introduction. It most likely came over in infested screenings, many other diseases and pests being imported in this way in foreign corn.‡

Modes of preventing attack.—The *early* sowing of wheat and barley is strongly recommended in districts where the Hessian-fly has been at work during the last few years. In all cases it is found that late-sown wheat is more liable to attack than that sown early in the season.

(α) In the case of *autumn* wheat, the *later* it is sown the better. In America and Canada, where autumn-sown wheat is started earlier than in Europe, this is a rule especially followed.§ The reason being simply this: that if the wheat is not up until the flies are hatched and dead it cannot suffer from the attack, and for this reason we are free from the attack of autumn wheat, which in America seems to do most of the damage.

(β) Agriculturists should also pay great attention to the kind of wheat sown, for some resist the attack much better than others. The stout-strawed varieties should be chosen. The following are found to resist the attack well: the "golden drop," "Rivett's red," "square head," "chaff red," amongst the wheats; and the "battledore," "awnless," and "bere" amongst the barleys. The finer varieties are all subject to attack. The thick-strawed varieties do not bend

* *Platygaster*, which is a genus of Hymenopterous insects, lays its eggs within the eggs of the Hessian-fly, and the victims do not live beyond the puparium stage, as the larvae of *Platygaster* devour them. The larvae of *Platygaster* undergo the most remarkable changes, they scarcely being recognisable as insect larvae; in many respects the larvae resemble the Crustacean *Cyclops* in appearance. Anyone interested in this curious development should read "Beiträge zur Erkenntniss d. Entwicklungsgeschichted. Insecten." *Zeit. f. wiss. Zool.*, Bd. xix., 1869.—Ganin. This author (Ganin) has given a very good account of their development. Another account may also be found in Balfour's "Comparative Embryology," 1880, vol. i., p. 345.

† *Entomologist*, 1887. Parasites of Hessian-Fly.—Miss Ormerod.

‡ "Ergot" is largely imported in this way.

§ It is recommended in Canada and U.S.A. that wheat should not be sown until after the middle of September.

down so readily as the others, and where they are healthily grown, they can resist any amount of attack.

(γ) The burning of stubble is an important point in aiding the destruction of these insects, and is a method that may be well adapted to other diseases. It may be done by commencing the firing at the borders of the field, so that the fire cannot spread outwards, but gradually gets smaller and smaller as it approaches the centre.

Dr. Packard, the American entomologist, however, is strongly of opinion that this remedy would be worse than useless, as large quantities of the invaluable parasites would be destroyed in the straw.

(δ) Deeply ploughing in the stubble can also be employed to great advantage, as the puparia, which are usually left in the stubble, cannot then develop satisfactorily. (When this is done the stubble should be cut high, so that the puparia are left.)

(ε) Corn and straw that is imported should also be well examined, and if the "flax seeds" are discovered, even in small quantities, should be destroyed at once.

(ζ) The stacking of infested straw should also be paid attention to. If it is stacked square, as hay, and firmly put together, a large number of the insects, even if they hatch, are unable to escape, and thus are not able to advance the disease.

(η) The destruction of all rank-growing weeds and grasses in hedges around the cornfields; for, as we have seen, the Hessian-fly infests certain kinds of grass, and most probably far more than we know. In this way the homes of many hundreds of flies may be destroyed.

(θ) Well-manured lands resist the attack, if a top-dressing of the following is added: "Two hundredweight of nitrate of soda and one and a half hundredweight of salt per acre."* Without this latter the crops will suffer from the attack.

The choice of soil for wheat and barley growing in the infested districts should also be noticed. In hot and dry places the crops suffer far more from the Hessian-fly attacks than in less exposed and damp surfaces. I have seen fields in Cambridgeshire, in dry and exposed places, badly attacked, whilst others close by have almost escaped.

There are said to be certain *cures*; but, as in all other cases, "prevention is better than cure." These cures are not satisfactory in the case of this pest. One of the most important is a "dressing of gas-

* Griffiths' "Diseases of Crops."

lime, which is said to destroy the larvæ of the pest"; but neither this nor the application of soot and lime can be strongly recommended.

Cecidomyia muricatae, Meade.

This species was discovered by Mr. Inchbald, and described by Dr. Meade,* in 1886, the perfect insect not being known before.

♂.—Head black, covered by white hairs. Face brownish-yellow, inner margins of eyes bordered by a yellow line. Palpi light yellow. Antennæ composed of seventeen joints, blackish-brown, nearly as long as the body. Joints petiolate and vetricillate, white hairs. Thorax blackish-brown, marked by three dark stripes, running longitudinally and gradually becoming less conspicuous as they pass backwards. Thorax covered by white and gray hairs, especially at the sides and in two lines on the dorsum. Roots of wings bright red. Shoulders marked with a yellow spot. Scutellum black at the base, reddish-yellow towards the end and sides.

Metathorax black. Abdomen dark reddish-brown, the first segment almost black; white hairs upon all the segments, especially at the sides, and a few at the borders of the segments. A brown band runs down the ventral surface on a flesh-coloured ground. Last two segments narrow and testaceous in colour, the male armature also testaceous. Halteres brown, knobs clothed with patches of white hairs.

Wings covered with a dark pubescence, veins clothed with scales, having a reddish tinge. The second longitudinal vein is straight and joins the costal in front of the apex of the wing. The under surfaces of the brown legs are clothed with silvery hairs. The knees and ends of tarsi pink.

♀ The female is distinguished from the male by the following points: 1. The antennæ smaller than ♂—about half the length of the body. 2. Joints of antennæ sessile; they lessen gradually as they approach the apex, the last joint being half as long as the preceding one. 3. Abdomen lighter than the ♂. 4. *The oviduct* long and slender, basal joint round, yellow; second joint elongated and brownish-black; the last joint being long and slender, yellow at base, brown in centre, and pink at the extremity. No terminal lamellæ.

The larvæ are found on *Carex muricata*, amongst the seeds and flower spikes. They feed "within the utricle on the embryo nucule, pupating in the spikelet."† In this position they pupate, forming a papery cocoon, towards the end of the autumn.

* *Entomologist*, 1886. A New Cecid.—Inchbald and Meade.

† Notes on Cecidomyidæ during 1886. *Ent.*, 1887.

The pupæ are red, and hatch during May.

The larvæ may be found during July, and are mostly pupated by February.

Cecidomyia clausilia, Bouché.*

This species infests the willow (*Salix alba*), forming small, half-moon pads on the margins of the leaves; a single larva inhabits each pad, according to Bremi.† Bergenstamm says,‡ "these leaf-rollings are the work of a *Phytoptus*, and thus the Cecid-larvæ may be looked upon as inquilines." According to Mr. Inchbald, in the paper mentioned, this is not the case, as far as his experience goes.

Imago.—General colour dark-black; abdomen dark reddish-brown; head black, with a reddish spot and a tuft of white hairs on the face. Antennæ 14-jointed in male; joints petiolated in ♂, sessile in ♀.

Thorax black, striped and shaded with gray; roots of the wings red. Scutellum yellowish-white. Abdomen reddish-brown, covered by dark scales, arranged in irregular transverse rows.

Genitalia of male small and black; the oviduct of the female is long and slender, with no launellæ; terminal joint yellow.

Halteres with pale stalks and black knobs. Wings clear, slightly hairy; second longitudinal vein straight in its whole course, terminating before the apex of the wing. Legs pale brown, with white hairs beneath; joints and ends of tarsi pink.

This species was found by Mr. Inchbald, and described by Dr. Meade, it being unknown in the perfect state to Bergenstamm.§

C. sisymbrii, Schrk. = *C. barbarea*, Curtis.

General appearance black; face reddish, with silvery-white proboscis and palpi. Antennæ dark, composed of sixteen and seventeen joints in the ♂ sixteen only in the ♀; longer than the body in the former, about half the length of the body in the latter.

Thorax dark reddish-yellow at the sides; wing covered by a dark pubescence, with dark veins; transverse veinlet very oblique, joining the first longitudinal near its middle; second longitudinal vein bent forward at its junction with the transverse veinlet, joining the border a long way from the tip of the wing.

The second branch of the third longitudinal vein curved obliquely

* Description of New Cecid. *Entomologist*, 1886, p. 213.

† Bremi. Trans. of Swiss Nat. Hist. Soc., 1847; and also 475, p. 85, Bergenstamm and Löw.

‡ "Synopsis Cecidomyiarum."

§ Synopsis, p. 36, "Imago unbekannt."

to the hind border. Halteres dark, with reddish tinge, sometimes slightly yellowish. The base of the femora yellowish beneath, tibiæ and tarsi shining white. Abdomen dark reddish-yellow, sometimes almost black. The oviduct is long, having the second and third segments yellowish-white ; no valves.

The larvæ form spongy galls in the stalk and inflorescence of the Barberry (*Barbarea vulgaris*) during May and June, and, according to Walker, from June to November, in the folded, blister-like galls of *Nasturtium sylvestre*, also in *N. palustre* and *Sisymbrium Sophia*.

The larvæ undergo their transformations in the galls, and do not pupate in the ground.

This species is figured by Winnertz,* and also by Loew in his "Dipterologische Beiträge" (Figs. 8 and 9).

Cecidomyia salicis, Schrk. =
$$\begin{cases} C. Salicina, Bouché. \\ C. Gallarum salicis. \\ C. Degeeri, Bremi. \\ C. Argyrosticta, Macq. \end{cases}$$

Black ; thorax with two stripes of whitish hairs. This insect is covered by silvery hairs, especially on the legs. In the male the joints of the antennæ are 20 to 22 in number ; in the female from 22 to 24 ; half the length of body, longer in the male. The basal joints twice the length of their petioles. Wings pubescent ; transverse veinlet at the end of the basal half of the first longitudinal vein. Halteres dark.

The larvæ of this willow Cecid form woody galls on the boughs and twigs of *Salix aurita*, *cinerea*, *caprea*, and *purpurea*. The larvæ pupate in the galls—not in the ground, as done by many other Cecids. Mr. Inchbald† describes the galls as "multilocular bosses on the upper twigs of *S. cinerea*." They appear during June.

C. acrophila, Wtz.

Black ; abdomen on ventral surface pink, with flesh-coloured markings on the sutures ; sides of the thorax also pinkish. Antennæ, 19 to 20 joints ; as long as the body in the ♂ ; joints and petioles of nearly equal length ; in the ♀ the antennæ are only half the length of the body ; both clothed by whorls of silvery hairs ; wings silvery or whitish in some lights. "Transverse veinlet placed before the middle of the first longitudinal vein ; second longitudinal vein bent forward at its junction with the veinlet ; curved hindward from thence to its tip, joining the costal at some distance from the tip of the

* "Linnæa Entomologica," 1853 (pl. ii., fig. 4).

† *Entomologist*, 1886, p. 35.

wing." Legs brown, shining white underneath. Oviduct long and brownish yellow; first segment flesh-coloured; no valves.

The larvæ live on *Fraxinus excelsior*, forming hollow elongated, pod-like aggregations, generally on the highest leaves. Before pupating they drop down to the earth and undergo their metamorphosis in the soil. The fly hatches in the spring.

This species does not seem to have been figured; but has been described by Winnertz, Walker, Schiner, etc.

C. betulae, Wtz.

The larvæ of this species pass the winter in the seed-capsules of the birch, *Betula alba*. They pupate in the same place. Sometimes two pupæ may lie side by side in the same capsule. The perfect insect commences to appear at the end of March and during April.

The perfect insect is dusky yellow, with the top of the thorax black; the abdomen also occasionally dark. Legs pale yellow. Antennæ dark brown, 12 to 13 jointed in ♂, apical joint with a very short petiole; in the ♀ twelve sessile joints. Wings limpid; transverse veinlet placed a short distance before the middle of the first longitudinal vein; second longitudinal nearly straight, joining the costa near the tip of the wing; the second branch of the third longitudinal bending round to the hind border. Halteres grayish-white. Third segment of oviduct white; no valves.

We know of no figure of this species. The metamorphosis was made known by Loew. Described by Winnertz, p. 234, Lin. Ent.

C. saliciperda, Duf. (the Willow Fly)

= $\begin{cases} C. albipennis, Lw. Wtz. Walker. \\ C. terebrans, Lw. \\ Rhabdophaga viminalis, * Westwood. \end{cases}$

The orange-coloured larvæ of the willow-fly may be found from July to the following April in the wood of young willows, under the bark—chiefly *Salix alba*, but also on poplars.† The ♀ lays chains of long yellow-coloured eggs. The larvæ dig out short, irregular passages, forming gall-shaped swellings, and causing the bark to become scabby and to crack and burst. Bergenstamm says "Verwandlung daselbst";‡ but this does not always seem to be the case.

The perfect insect is black, clothed with black hairs. The thorax is grayish, with four indistinct black bands; sides of the abdomen

* *Lin. Ent.*, 1851, p. 373.

‡ *Sy. Cecid.*, 70.

† *Gard. Chron.*, 1847, p. 588.

with red markings. Wings dusky white and hairy; apex of the halteres also dusky white. Costal vein dark brown, second longitudinal vein straight ends at some little distance from the tip of the wing. The transverse veinlet in ♂ is before the middle of first longitudinal vein; in the ♀ at the middle of first longitudinal. Antennæ yellowish-white, composed of 15 joints. Silvery hairs on the legs.

These willow-flies only live twenty-four hours, and are found in many parts of Europe besides England. They are subject to several parasites, including *Tryidymus salicis*, *Torymus salicicola*, and *Eurytomus* (*sp.?*).

Cecidomyia nigra, Mg.*

This species is placed amongst the reputed British Cecids in Verrall's list. It has, however, been found in England in recent years, and can fairly be entered as a British insect. The Rev. E. N. Bloomfield, of Guestling, showed me many of the larvæ of this species a few years ago. They were remarkable for their saltatory powers. They affect the cores of young pears, destroying the pulp, and causing the pears, when only partly formed, to drop off. They form blackened tunnels from their cavity in the pulp in all directions. Mr. Bloomfield found they used the "Marie Louise" pears for their nurse, whilst we have found similar larvæ in the "William" pear. They are yellowish-white in colour, and, according to Mr. Inchbald, pupate in the soil, spinning a papery cocoon enclosed in a case of earth,† and also according to Bergenstamm. This possibly belongs to the sub-genus *Diplosis*.

C. brassicæ, Wtz.‡ = *C. napi*, Lw.

The larvæ of this species live in the flowers and leaves of the cabbage (*B. oleracea*) and in the pods of *Napus* and *Cheiranthus*, Walker§ says as many as fifty to sixty live in one pod of the rape (*B. rapa*). The turnip (*napus*) suffers largely from this larva in parts of England. They appear in May and June, and change in the earth.

Imago black. Abdomen red, black bands on the dorsum. Palpi white, antennæ 15-jointed, with long whorls of hairs in the ♂; joints petiolate. In the ♀ the joints are sessile and the hairs much shorter, antennæ not half the length of the body. Base of the halteres rose-coloured. Wings limpid, with black veins. First longitudinal near

* Meigen, "Systematische Beschreibung der bekannten europäischen Zweiflügeligen Insekten." Aachen, 1818, pl. iii., fig. 11.

† *Entomologist*, 1886, p. 35.

‡ Lin. Ent., p. 231, Winnertz. Laboulbène, Ann. Ent. Soc., Fr. 1857.

§ Ins. Brit., vol. iii., p. 84.



Cecidomyia, 1A.



Campylomyza, 6A



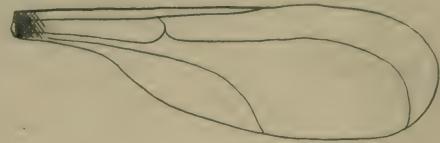
Diplosis, 2A.



Lestremia, 7A.



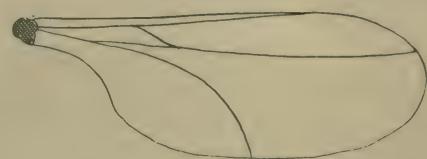
Epidosis, 3A.



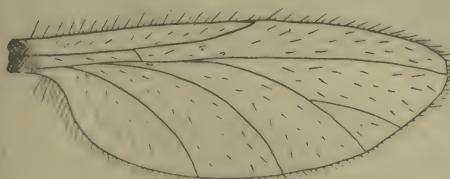
Colpodia, 8A.



Asynapta, 4A.



Spaniocera, 9A.



Catocha, 5A.



Lasioptera, 10A.

WINGS OF SOME CECIDOMIYIADÆ.

PLATE I.

the costa, transverse veinlet joining it near its centre. Second long vein joining the costa far from the tip of the wing. Silvery hairs on the under surface of the legs.

The *larvae* are milk white, with yellow intestine, the skin being granulated. Winnertz also says, "der Hinterrand des vorletzten Ringes mit einigen Borsten haaren bekranzt." They are found in Junc.

C. rosaria, Lw. = *C. cinerearum*.

The larvae form rose-shaped galls on the ends of the boughs of various willows, as *Salix alba*, *aurita*, *Caprea*, *purpurea*, *cinerea*, etc. Each larva inhabiting a separate gall, they metamorphose in the rosette. The general appearance is dusky-black, with silvery hairs. Thorax with two stripes of silvery hairs, the sides and base of wings flesh-coloured, halteres reddish-yellow with brown tip. Antennæ as long as the body in the ♂, 20-22-jointed, sometimes as much as 24-jointed. Palpi yellowish-brown. Wings gray, iridescent, with blackish-gray pubescence. Costa and second longitudinal vein thick and black, the latter especially in the middle, and ending hardly in front of the tip of the wing. The second branch of the postical curved obliquely to the posterior border. In the ♀ antennæ 22-24-jointed. Winnertz says :* After death the colour of this insect is blackish or dusky-brown to black, with reddish-yellow bases to the wings.

C. taxi, Inch.

No cocoons are spun within the close-fitting nest of whitish leaves composing the interior of the gall.

Pupa 1 lin. long, notched between thorax and abdomen, reddish, eyes black. The pupa passes up the tract of the gall, and the white pupal skin remains with the "feeler" sheaths.

The *imago* is between *C. rosaria* and *riparia*. They live only two or three days. An *ichneumon* is parasitic on this species.

C. urticae, Perris, "The Nettle Gnat."†

This species forms pale green hairy galls in the stem and leaf of *diuina* (the nettle). June to September. A single larva inhabits each gall; the first segment very slender; second broader, one-twelfth as broad as the third; the fourth to the seventh each a little broader than the preceding; the eighth is the largest; the segments then decrease until the fourteenth. No cocoon is spun. They pupate in the ground.

Pupa.—Forehead broad, armed on each side by a protuberance; respiratory pointed tube behind each eye on the thorax; yellow, tips

* Lin. Ent., i., fig. 17; ii., fig. 1; iii., fig. 1; also vol. ii., fig. 23, in Bremis' "Beiträge zu einer Monographie der Gallmücken."

† Larva palpi (figs.), Lin. Ent. T. 8, Taf. 1.

fuscous. Head fuscous. Wing-cases pitch black; antennæ and legs black; abdomen dirty yellow.

Imago.—Tawny, head yellow. Thorax has three brown stripes. Wings with dark borders. Halteres brown, yellow at base. Abdomen dirty yellow, black hairs. Legs black, femora at the base, and coxae yellow.

C. terminalis, Lw. = *C. fragilis*.

Twenty to thirty ova are laid on shoots of *Salix fragilis*. The larvæ, which are yellowish-red, live in bloated galls, and live fourteen days. They pupate in the earth. When the larvæ have left the shoots, many scars appear between the healthy and the galled parts (= woody cells). The same process takes place which takes place at the fall of the leaf in autumn.

Imago.—Brownish-black; antennæ brown or yellow at the base; 19-jointed in ♂, 16-jointed in ♀. Abdomen tawny beneath. Oviduct long, last two segments yellow. Costa of wings thick, deep black; veins dark brown; transverse veinlet, situated about the middle of the first longitudinal vein; second long. vein curved towards the tip, ending at some little distance in front of the tip of the wing.

C. campanulae, Müll.—Larvæ form galls on the seed vessels, and live also in green galls (axillary), developed from buds, or may be in terminal clusters on *C. rotundifolia*. Red larvæ, with first segment beak-like. *Imago* unknown.

C. bursaria, Bremi.

Galls on *Glechoma hederacea*; they are tubular bodies, with one pale larva; when full fed the tubes become detached and fall. Fig. 12 (2).

Imago.—Crown of head raised conically. Reddish-yellow; thorax has three confluent black lines and dark gray hair. Abdomen dark brown. Palpi yellow, crown black. Antennæ brown. 18-jointed, petioles shorter than joints. Legs blackish-brown, whitish beneath, yellowish at their junction with body. Wings gray, scarcely iridescent, dark thick gray hairs. Antennæ of ♀ shorter than ♂, petiolate as in ♂. Oviduct very long and yellow.

C. veronicae, Bremi = *C. chamædrys*, Inch.

The larvæ form tufts of leaves, forming a hairy pouch on the barren stems of *Veronica chamædrys*. Fig. 12 (5). The larvæ change in these nests. Pupa figured by Winnertz in "Linnæa Entomologica," Taf. 1.

C. Crataegi, Wtz. = *T. oxyacanthæ*, Schk.

In white-thorn hedges we often see the shoots terminated in tufts and knobs; each of these is a gall tenanted by several of the larvæ

of this fly. They sometimes pupate in the leaf-tufts of *C. oxyacanthus* and *coccinea*, sometimes in the earth.

Imago black, with yellowish palps. Antennæ 16-jointed in ♂ : 15-jointed in ♀. Oviduct long, and yellow at the tip. Sides of thorax and meta-thorax flesh-coloured. Abdomen flesh-coloured, with black bands. Halteres white. Wings hyaline ; black pubescence and costa. Second long. vein bends forward at its junction with the transverse veinlet, then, passing in an almost straight line, joins the costal a little distance from tip of wing. Length, $\frac{3}{4}$ lin.

C. galii, Wtz. = *C. molluginis*, Lw.

The larvæ live in the blister-like galls of the flowery stalks of *Galium mollugo*, *uliginosum* and *verum*. They pass to pupal state in the earth.

Imago.—Yellow, head brown, tip of the palpi yellow, three dark bands on thorax, pectus shining. Wings limpid, veins and costa dark. Abdomen tawny, with black bands. Legs silvery underneath. Antennæ in ♂ 17-jointed, 16 or 17-jointed in ♀. Oviduct long and yellow. Length, $\frac{3}{4}$ lin.

C. pyri, Bouché.

Pear trees are affected by this cecid, especially young trees. The larvæ form and live in the rolled-up borders of the leaves, and pass to the earth to metamorphose. The imago is dark brown, with limpid wings, and tawny palpi. Transverse veinlet joining the middle of the first long. vein ; second branch of the third longitudinal curved to the hind border. Length, 1 lin.

C. Persicariae, L., infests the leaves of *Polygonum amphibium* and *Persicariae*. This is a black species, with a flesh-coloured abdomen, with dark hairy bands. The larvæ may be found in July.

C. Euphorbiæ, Lw. = { *C. subpatula*, Bremi.
 C. capiteana, Bremi.

According to Walker, the larvæ of *Euphorbiæ* live in the tips of the leaves of *Euphorbia Cyparissias*. Perris,* in his account of the "Insectes du Pin Maritime," says, "L'extrémité des tiges de l'*Eup. amygdaloides*." They pupate in the galls. Bremi figures the galls, wings, palpus and antennæ.†

Imago.—Black ; antennæ fuscous, 16-jointed ; the abdomen is flesh-coloured, with bands of black, which in the ♀ are hairy ; wings with dark pubescence ; transverse veinlet, which in some specimens is very indistinct, is situated at the middle of the first longitudinal vein. Second longitudinal nearly straight, ending near tip of wing.

* An. Ent. Soc. Fr., 1870, p. 179.

† Mon. de Gallmucken, pl. i., figs. 2, 5 and 7 ; pl. ii., fig. 25.

Legs almost black, white beneath. Oviduct long, the third segment yellow. Male genitalia dark.

C. galeobdolontis, Wtz.* = *C. Strumosa*, Bremi.

The larvæ live in the stalks of *Galeobdolon luteum*, and form woolly galls. The description of this species is taken from Inchbald's paper quoted below.

♂ Antennæ with joints not pedicelled as in the ♀. Wings limpid, gray pubescence in both sexes, the anal fork extending to the inner margin, more deeply coloured in ♂ than in ♀. Halteres darker (than ♀). Abdomen prominently forcipated. Legs longer in comparison of its size.

♀ Antennæ fuscous, 13-jointed, pedicellated. Thorax with disc pale fuscous. Halteres pale yellow. Oviduct pale yellow. Bremi in his monograph gives a good figure of the gall of this species (Pl. II., Fig. 26), and says concerning it: "In den gallen, welch ich dieses Jahr Ende Februaris fand, und welch vorzüglich gross und ganz frisch waren beobachtete ich die Larren bereits eingesponnen, aber noch nicht in nympthen verwandelt."†

The imago appears in May and June.

C. salicina, Schrk. = *C. Frischii*, Bremi.

Imago.—Brownish-black; face and palpi brown, yellowish bands on the side of thorax. Abdomen pinkish-brown, with black bands on the dorsum; tawny beneath in the ♀. Costa of wings thick and almost black; second longitudinal vein very nearly straight, ending near tip of wing. Antennæ, 16-17-jointed in ♂, as long as body; in the ♀ always 16-jointed, about half the length of body. Legs with silvery hairs on under-surface; halteres white, gradually becoming dusky at the apex.

Walker says, "The larvæ live in the withered tips of the young shoots of *Salix Caprea* and *S. alba*, and also according to Muller."‡ They live in the young terminal leaflets of the shoots, which wither away and form a bud-shaped nidus, three to eight larvæ in each.

C. serotina, Wtz.

The larvæ live in the tops of the shoots of *Hypericum humifusum*; they drop to the earth before pupating.

Imago.—Blackish-brown; head, antennæ and palpi brown; antennæ, 16-jointed in ♀; 16-17-jointed in ♂. The halteres are pure white in the living specimen, drying yellowish white. The abdomen of ♂ is sometimes tawny; each segment having black hairs on the posterior border; in ♀ the abdomen is flesh-coloured,

* For more detail refer to Ent. W. Int., 1861, p. 69.

† See Ent. W. Int., 1861, p. 56.

‡ Ent. Mo. Mag., vi., 1869, p. 109.

with hairs the same as in the ♂. The oviduct elongated and white, or light brown, the ♂ genitalia brown. The first longitudinal vein very near costa. Second longitudinal vein joins the costa some way from the tip of the wing.

C. cardaminis, Wtz.

The larvæ of this Cecid feed on the flowers, etc., of *Cardamine pratense* and *amara*, and destroy all the parts they attack, usually picking out those plants that grow on damp and spongy ground; the white *amara* often assuming the purple hue of *pratense* through the action of these insects. They change to the pupa state in the earth.

The *imago* is black; thorax with three dark bands on a light ground colour; scutellum sometimes pinkish; abdomen tawny; 16-17-jointed antennæ; in the ♂ the petioles of the joints near the base are short, those in the middle one-fourth shorter than the joints, antennæ as long as body; in ♀ they are much shorter, and the abdomen is rose-coloured, with dark-brown or black hinder borders to the segments. Wings darkly pubescent; brown veins; first longitudinal vein very near costa; second longitudinal vein bending forwards at its junction with the transverse veinlet, and joins the costal at some distance from the tip of the wing. In the ♀ the second longitudinal is straight from the transverse veinlet to the border.

C. heraclei, Klth.

Concerning this species, Löw and Bergenstamm* say the *imago* is unknown. The larvæ are social and live on the leaves of *Heracleum Spondylium*, and pupate in the ground.

C. heterobia, Lw. = { *C. strobilina*, Bremi.
 C. saligna, Hardy.

The larvæ of *heterobia* live in the ♂ flowers and in rosettes on the leaves of *Salix amygdalina*. The larvæ mentioned by Perrist seem to be referred to this species. Concerning the galls he says: "Darts ce feutre vivent de nombreuses larves de Cécidomyie." They pupate where they live. They also live as "inquilines" in the galls of *C. rosaria*.

The *imago* is dusky brown to black; abdomen tawny beneath; scutellum and end of thorax pinkish. Legs fuscous, paler on under surface. Antennæ of ♂ 17-19-jointed; 16-jointed in ♀. Oviduct long, last two segments yellowish-brown. Costa of wing very thick and dark; transverse veinlet pale, meeting the first longitudinal about its middle; second longitudinal vein generally straight. Second branch of third vein curved so as to form an obtuse angle.

* Syn. Cec., p. 47.

† An. Ent. Soc. Fr., 1870, p. 180.

C. pteridis, Müll. = *C. filicina*, Kief.

Imago unknown. Müller describes the larvæ as reddish in colour, living in the "rolled" and "laid down" leaflets of the fronds (of *Pteris*). One larva in each leaflet. The leaf-rolls are at first green, then they become cigar-shaped and reddish, and as soon as the larvæ pass to the earth they become black. Perris* describes the habits as follows: "Au mois de juin, en observant avec soin les feuilles de la grande fougère, *Pteris aquilina*, on remarque ça et là des folioles roulées en dessous d'un peut côté, la partie roulée étant ordinairement brunâtre, ce qui la rend plus apparente. Si on la déroule avec précaution on met à découvert une larve Cécidomyie d'un blanc rosé."

$$C. pustularis, \text{Bremi} = \begin{cases} C. quercus, \text{Lw.} \\ C. roboris, \text{Hardy.} \\ C. reaperiens, \text{Bach.} \\ C. inflexa, \text{Rudow.} \end{cases}$$

Imago unknown according to Bergenstamm. Hardy gives an account of this in the "Scottish Gardener," iii., 1854, which I have been unable to obtain. The larvæ are said to live chiefly in the leaves of the oak; the lobes of the leaf being folded and laid down on the under side, forming a hollow for two or three larvæ. The folds are paler than the leaf. The larvæ pupate in the earth.

C. thalictri, Traill.

As far as I can make out this only appears to have been mentioned by Löw.† Bergenstamm says, "Imago unbekannt." The larvæ live in the deformed fruit of *Thalictrum*.

$$C. tiliæ, \text{Schrk.} = \begin{cases} C. limbivolens \\ C. excavans \end{cases} \text{ Macq.}$$

The *imago* likewise unknown. Concerning the larvæ Walker says: "In June the galls‡ of *C. tiliæ* are not uncommon on the young shoots growing from the stumps of lime-trees by the banks of the Wye, near Chepstow. They are round or oblong, green on one side, bright red on the other. Some of them contain more than twenty separate cells, each inhabited by one larva. The latter is about one line of length, of a bright yellow colour, and has the faculty of leaping, like the larva of *Piophila*. It is full grown in the third week in June."

Bergenstamm says: "Die Larven leben gesellig in dem nach oben eingerollten Blattrande von *Tilia europæa*."

* Tr. Ent. Soc. Fr., 1870, p. 180.

† D. B. iv., 1850, p. 30.

‡ Ins. Brit. Diptera, iii., p. 130. Bremi in his monograph figures the galls of *C. tiliacea* on the leaf of *T. Europæa* in several stages.

C. Tornatella, Bremi.

The larvae produce smooth light green, nearly cylindrical one-celled galls, on the top leaves of *Fagus sylvatica*, one larva in each gall, in which it pupates. *Imago* unknown, Fig. 12 (1).

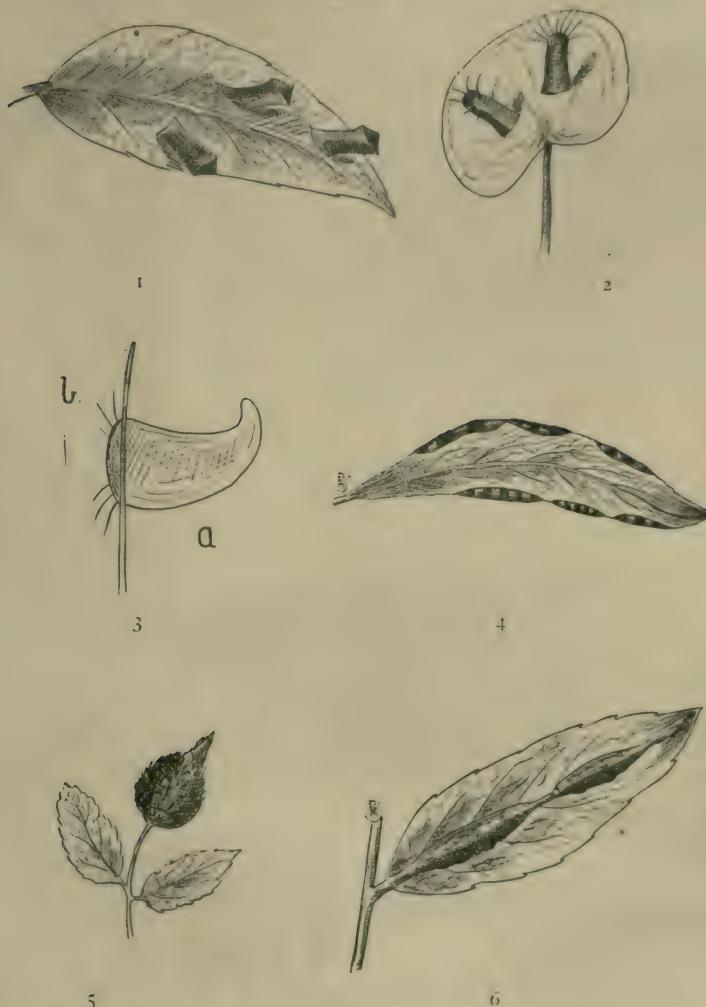


FIG. 12.—Galls produced by some Cecidomyiidae.—1. *C. Tornatella* on *Fagus sylvatica*; 2. *C. bursaria* on *Glechoma*; 3. *C. ulmaria*—a = under-surface; b = upper-surface; 4. *C. marginemtorquens* on *Salix viminalis*; 5. *C. Veronica* on *Veronica*, sp.; 6. *C. Fraxini*.

C. trifolii, F.

The larvæ live in the united leaflets of *Trifolium pratense* and pupate there. This species is described and figured by Löw.*

C. ranunculi, Bremi. The "Buttercup Gnat."

The larvæ of this gnat live in the leaves of *Ranunculus bulbosus* and *Trifolium pratense*.

The *imago*.—Head yellow, with some brownish markings; crown, antennæ and eyes black: antennæ in the ♂ 13-jointed; joints irregular, spherical; gray hairs. Thorax reddish-brown to black, sides and pectus yellowish; wings gray; halter steel-gray; head long and dark. Abdomen tawny, dark bands on the dorsal surface.

C. rhododendri, Vallot.

Vallot † gave an account of the "Rhododendron Gnat" galls some time ago. The larvæ live in bud-shaped pustules on the upper twigs of the *Rhododendron*. The *imago* appears to be unknown.

C. rosarum, Hardy = *C. rosæ*, Macq. and Bremi.

Bremi ‡ in his monograph figures the galls produced by the larvæ of *rosæ* as swellings on the back of the leaves of *Rosa incana*. Hardy, § who describes this species, also gives a vague account of the larvæ of some rose parasites, but the species are not definitely stated.

Imago.—Small, black, and shiny; posterior margin of thorax, base of wings, apex of scutellum and metathorax may be flesh-coloured; abdomen pinkish, with black markings on the ventral surface. Legs long and slender. Costal and first longitudinal vein dark. Antennæ 14-jointed in ♀, black, short, and slender: joints surrounded by numerous long verticillate hairs. Halteres light. Length 1½ lin.

C. pruni, Kltb.

Moncreaff || describes the galls as "boat-shaped" bodies, and bred from them a number of parasites, as *Callimome macropterus* (Walker).

C. ulmariae, Bremi.

This gnat appears in August. The larvæ live in wart-like galls on and under the leaves of *Spiraea ulmaria*. The galls are hood-

* V. z. b. G., 1874, p. 143, pl. ii, fig. 4.—F. Löw.

† Mém. Acad. Sc. Dijon, 1836, p. 190.

‡ Mon. der. Gallmücken, pl. ii, fig. 31.

§ An. and Mag. Nat. Hist., 1850, p. 186.

|| Entomologist, 1870-1871, p. 240.

shaped on the under surface and pale in colour. I once found many on the Meadow Sweet, near Eastbourne. The metamorphosis takes place in the gall, Fig. 12 (3).

Imago.—Brownish-yellow, head yellow, antennæ and palpi brown, some faintly yellow. Thorax marked by three dark-brown stripes. Abdomen tawny, with bands of dark, dense hairs. Legs dark brown, lighter beneath. Wings dusky. Transverse veinlet indistinct, meeting the first longitudinal near its centre; the second longitudinal vein joins the costa far from the tip of the wing. Halteres yellowish-brown. Oviduct long; first segment reddish-brown, remainder yellow. Length $\frac{1}{2}$ in. Kidd* describes the gall as follows: "On the upper side of leaf the gall is hemispherical, nearly smooth and pink; small, size of mustard-seed; on the under surface the gall is produced into a snout-like cone and is pubescent."

C. lathyri, Fefld.

The larvae of this gnat are social and live in galls deforming the young shoots of *Lathyrus sylvestris*. Some metamorphose in the galls, others in the earth. The *imago* appears to be unknown.

C. marginemtorquens, Wtz. Bremi.

The larvae live in the deformed leaf borders of *Salix viminalis*, and pupate there. They are gregarious.† The leaf-borders become infolded and swollen, generally in elliptical patches, but sometimes extending all around the leaf. When young these deformations are variegated with red, yellow, and green, Fig. 12 (4). The *imago* is black; face, sides of the thorax, scutellum and metathorax tawny. In the ♂ antennæ are 15-16-jointed, as long as the body. In ♀ antennæ 15-jointed, only half the length of body. Palpi pale yellowish-brown. Abdomen yellowish-brown, with broad black hairy bands on its dorsal surface. Wings covered by darkish hairs, costa dark, transverse veinlet pale, situated in the middle of the first longitudinal; the second long. vein joins the costal at some distance in front of the tip of the wings. Legs dusky-brown, hairs white, changing to yellowish-brown in death. Oviduct long and slender at the end; first segment broad and dark, remainder lighter in colour.

C. medicaginis, Bremi.‡

The larvae live on *Medicago sativa*, forming a deformation between leaf-stalk and stipule; they are gregarious, and pupate in the earth.

* *Ent. Mo. Mag.*, 1868, p. 233.

† Müller, *Ent. Mo. Mag.* vi., 1869, p. 109, and Bremi, *Mén. Gall.*, 1847, pl. ii., fig. 32.

‡ *Mén. Gall.*, p. 17, pl. i., fig. 16.—Bremi.

C. onobrychidis, Bremi.

The larvæ live gregariously, and, according to Bergenstamm, "in hülsenformig zusammengefalteten Blättern von *Astragalus onobrychis* und *asper*, *Medicago falcata*, *sativa*, *lupulina* und *Onobrychis sativa*." They pupate in the ground.

Bremi gives a description of this species which answers nearly to the following: Head black, also the antennæ, which in both sexes are strongly hairy; in the ♂ they are 14-jointed and as long as the body, the spherical joints being far apart; in ♀ antennæ only half the length of body, 12-jointed. Thorax dark and shiny; sides of thorax and pectus reddish, halteres also reddish-brown. Wings limpid, nerves deep black, first and second longitudinals strong, pubescent. Legs brownish-red, tarsi pale. The ♀ is stout and reddish, each segment having a black band on it; ovipositor thin and pointed; the ♂ is slender and almost black, on account of the development of the black bands on the abdomen; ventral surface of abdomen tawny in both sexes.

C. foliorum, H. Lw. = *C. fulcorum*, Macq.

This is a somewhat rare gnat, the larvæ living in a small-sized gall on the leaf of the wormwood, *Artemisia vulgaris*.

The *imago*.—♂ brown; bases of wings and body red, the latter having two rows of dark spots. Antennæ 15-jointed. Wings brownish-gray, first longitudinal vein very strong, second quite straight, ending near tip of wing; wing fold like a vein. Legs slender and brownish. Points of the tarsi brown. I can find no record of the ♀.

C. plicatrix, Lw.

The larvæ live gregariously when young, and curl up the leaves of *Rubus cæsius* and pass to the ground before metamorphosing.

Imago.—Dark brown, sometimes with a reddish tinge. Abdomen red, with dark brown rows of scales. Antennæ 14-jointed; each joint has a double row of hairs, the upper row the longer; antennæ red at base, brown above, joints sessile in ♀. Wings short and broad. Third longitudinal ends a long way in front of tip of wing. Legs brown, not very slender. The following are also British species belonging to this sub-genus:

C. pilosellæ, Binnie. = *C. potentillæ*, F. *C. violæ*, F. *C. alpina*, Lw. *C. tubicola*, Keif.

SUB-GENUS.—*Diplosis*, Lw.

D. coniophaga, Wtz. = *C. oidii*, Hardy (Scot. Gard., 1854, p. 170 [?]).

The larvae of this species live on the leaves of various plants, especially on the following: *Betula*, *Populus*, *Rosa* and *Salix*; Bergenstamm and Löw also give *Cirsium* and *Lactuca*. Walker says "they live with *D. Ceomatis** on *Ceoma miniatum*, on the fallen leaves of *Rora*, and feed on that fungus."† They feed on the spores of the fungi, and pupate in the ground.

The *imago* is yellow, the dorsum has three brown markings; abdomen, each segment has white hairs upon the posterior margin; legs brown; wings transparent, with thick gray hairs (Schiner); transverse veinlet joining the middle of the first longitudinal vein. $\frac{3}{8}$ to $\frac{2}{3}$ lin.

D. loti, Deg. = $\begin{cases} \text{Tipula loti, Deg.} \\ \text{Cecid. loti, Meigen.} \end{cases}$

The larvae of this species have the power of leaping well developed; this saltatorial habit seems common to this sub-genus. Löw remarks "that all such larvae belong to the sub-genus *Diplosis*."‡ If this is the case, *C. nigra*§ belongs here. The larvae of *loti* live in the flowers and in the husks of the seeds of *Lotus corniculatus*, *Medicago sativa* and *Vicia cracca*. Many larvae may live in the same flower-head and form curious gall-like deformations. They pupate in the ground.

Imago.—Blackish-brown; neck and scutellum dirty whitish-yellow; scutellum with yellowish little hairs. Wings have a dark pubescence and brown veins, dorsum has two rows of whitish-yellow hairs. Ovipositor large, black, yellowish in parts.

D. tremulæ, Wtz.—"The Aspen Gnat."

= $\begin{cases} \text{Tipula populea, Schrank.} \\ \text{Cecid. polymorpha, Bremi.} \end{cases}$

The larvae|| of the "Aspen Gnat" seem to form two kinds of galls; the first are formed on the leaves of *Populus tremula*—these are red galls the size of a pea—the second kind is the well-known gall formed on the leaf stalk: each gall is inhabited by a single larva, which pupates in the ground (Winnertz).

Imago.—Dorsum blackish-brown, with two rows of whitish-yellow

* Described by Walker, but only considered a reputed species by Verrall. The four brown spots on the white wings easily distinguish this species from *D. coniophaga*.

† Ins. Brit. viii., p. 106. '*Rora*' being a misprint evidently for *Rosa*.

‡ Mon. of N. American Diptera, Osten-Sacken, pt. i., p. 183.

§ *Vide* note at end of Chap. IV.

|| *Vide* pl. i., fig. 2, vol. viii., Lin. Entomologica.

hairs ; abdomen dark brown, with thin, flesh-coloured incisions and white hair. Posterior half of seventh ring, and the rest of the abdomen, flesh coloured ; ♂ genitalia black ; ♀ yellow. Wings large, gray, with thick blackish-gray hairs, third longitudinal vein bending in an almost straight angle to the posterior edge ; 1 to $1\frac{1}{2}$ lin.

D. tritici, Kirby.—“The Wheat Midge.”

This is a very interesting species, on account of its being so injurious to wheat, etc., and therefore we deal at greater length with this than with most species.

The eggs are transparent, cylindrical, rounded at both ends, four times as long as broad ; they are laid in little heaps of six to thirty in the inner bloom of the wheat, close to the embryo grain.

The larvæ hatch in eight or ten days, first transparent, then yellow, changing to orange. Composed of 14 joints, the last cut out and curved, with four little teeth. When it wishes to push itself forward, it first curves itself round and holds on to some firm support. It feeds on the germs and flowers of the wheat, and seems to possess the power of jumping to the ground, where it buries itself from one to five inches deep for about fourteen days, after which it changes to a pupa. Before burying itself, the larva sheds its skin and appears covered with fine-pointed hairs.

Pupa.—Reddish-yellow, and apparently enclosed in a filmy transparent case. Two bristles on the forehead.

Imago.—Citron yellow, with downy hairs ; antennæ blackish ; eyes black ; legs pale yellow ; wings covered with strong hairs ; antennæ of ♀ $\frac{3}{5}$ length of body, 13-jointed, hairy ; those of ♂ $1\frac{1}{2}$ times length of body, 25-jointed ; thorax of ♀ gray ; abdomen has brown edges ; ovipositor can be extended to twice the length of the body, and is as thin as a hair ; wings of ♂ twice as long as abdomen. Length of ♀ 1.5 to 1.6 mm. ; of ♂ 0.9 to 1 mm.

The “Wheat Midge” comes out in June and July, and has been seen in England as late as the 17th August. The ♀ seems to fly about amongst the wheat stalks during the day, to begin laying eggs an hour or two before darkness begins, and to continue laying throughout the night. These “Midges” are also found in grass along hedge sides and in clover.*

There are probably two broods or more in one season. It attacks wheat and rye, and according to Wagner, barley and oats also. Some think that on first emerging it lays eggs on couch grass, and perhaps

* Manual of Inj. Insects, p. 90.—E. A. Ormerod.

on other grasses, and that broods from these infest the wheat ; the reference above is certainly in favour of this theory. The "Wheat Midge" is attacked by *Platygaster tipulae*, which lays eggs within its eggs by means of a very long ovipositor, and by *Macroglenes penetrans*, which lays eggs within the larvæ. This insect was first recorded in England in 1776, then in North America, then in France, and later in Austria, Hungary, Germany and Prussia.

Prevention and Remedies of Attack :

Miss Ormerod says (in the work mentioned before) : "The best method for prevention of this 'Red Maggot' is to give it no winter shelter, which is *naturally* at the roots of the corn crops or of couch grasses, and *artificially* in large chaff-heaps. The chaff-heaps and the rubbish and dust from the threshing machine can be easily managed, and in the fields a great deal of the 'Red Maggot' may be got rid of by special methods of ploughing, or by taking the cultivator through the land and collecting and burning the stubble roots."

In America various methods of ploughing in the stubble and top soil, and thus placing the "Red Maggot" under unfavourable conditions, are employed. But one of the most important points in preventing the spread of this pest is entirely doing away with those hot-houses of "Wheat Midge," namely, heaps of chaff and dust from the threshing machine, which are so often seen. Not only does this mode of heaping the chaff seem to hasten and favour development of the Midge, but it enables the breeding to take place more freely, for we know that very few ♂'s are found in the cornfields, and Miss Ormerod, from her observations, thinks that the pairing takes place amongst the countless number seen over these heaps ; if, then, these were burnt or placed in unfavourable conditions, such as in cattle yards, much good might be done by not only retarding development of the "Red Maggot," but by stopping the further production of the species.

Dr. Taschenberg recommends the destruction of couch grass near cornfields, as it harbours this fly to a large extent, and he further says : "The meadow foxtail grass is certainly at present open to suspicion of infestation."* Griffiths† says destroy especially the wild oat grass (*Avena fatua*), upon which the larvæ of the wheat fly feed.

D. Fraxinella, Meade. } "The Ash-cauliflower Gnat."
 = *C. Minuta*, Wtz.

Dr. Meade says this is probably the same as *C. minuta*, of Winternitz. It seems to be intermediate between *Diplosis* and *Cecidomyia*.

* *Practische Insectenkunde*, pt. iv., p. 16 ; also *vide American Gov. Reports*.

† *Diseases of Crops*, chap. iv., p. 117.

Lives as an ingulbine in the cauliflower ash gall.* It is a small yellowish-brown gnat with black head; palpi and proboscis pale yellow, a tuft of white hairs on the face. Thorax brownish-yellow, with three brownish-black longitudinal stripes nearly confluent on the ♂. Abdomen yellow, white hairs, base black.

D. helianthemi, Hardy.

The larvæ live in the terminal leaves of *H. vulgare*, collecting them into bunches and stopping the growth. They usually are found at the base of these amalgamated leaves, sometimes in great numbers. The larvæ have a few hairs on each segment and several apical ones. The anchor process is dark testaceous. Length about one line. They appear in June and July.

The *imago* is very small and yellowish-brown; the thorax is yellowish with brown markings; eyes brown; scutellum reddish-brown; face, antennæ and palpi yellowish; the antennæ are 14-jointed in the ♂. Wings moderate-sized, of a yellowish tinge, the veins slightly marked with bands having spots of an ash colour, the ends of the bands having seven ash-coloured spots on the edge. Halteres pale. This species has been described by Hardy in the Annals of Natural History, in 1880.

D. buxi, Laboulb.
 { *Tipula flava*, Sch.
D. Schineri.

The larvæ live in blister-like galls on the leaf of *Buxus sempervirens*, and pupate in these inflated patches. Laboulbène † gives a good series of figures relating to this species.

Imago.—Yellowish; metathorax reddish and of a rather rosy tint. On the back of prothorax are three bands, one median and two lateral, not well defined and slightly brownish. Wings in ♀ transparent and more opaque in the ♂, veins yellowish in ♀; hairy. Halteres yellow at base, red at the tips. Abdomen yellow, extremity deep orange in ♀, brown in ♂. Ovipositor brown. Feet yellowish; thighs dark gray, black hairs. Tarsi yellow; first joint shortest; second very long. The body is hairy. Pl. ii. (7).

D. botularia, † Wtz.—“The Ash Midge.”
 = *C. fraxini*, Br.

In many parts of England, but especially in Kent and Surrey, the leaves of the ash in sheltered places are seen to turn yellow and fall off prematurely in July and August. They are known as “blighted” leaves, a name which may mean anything. These infected leaves

* *Ent. Mo. Mag.*, 1888, p. 23.

† *Ann. Ent. Soc., France*, 1873, pp. 313-326, pl. ix., figs. 1 to 17.

‡ *Gard. Chron.*, Dec. 31, 1870.—Müller.

are distorted and crumbled ; with thickened mid-rib ; this is enlarged chiefly on the under surface of the leaf. The sides of the leaves are folded over, and they resemble a pod. These galls are pubescent.

Each cell contains a single larva, reddish-yellow in colour. When the larvae require to fall to the earth to pupate, the galls, through lack of nutriment, split, and the larvae escape by this crack. Pupa skin silvery white ; three weeks in this state, Fig. 12 (6).

Imago.—Reddish-yellow ; three pale brown streaks on thorax ; halteres white ; abdomen brown, hind border fringed with white hairs. Legs brown, white pubescence. Wings grayish, violet iridescence, veins brown. Antennæ 26-jointed in ♂, 14-jointed in ♀.

D. linariae, Wtz.

The larvae live in tufts formed on the tips of the buds of *Linaria vulgaris*. They pupate in the same place.

The *imago* is yellow ; the antennæ brownish-yellow ; thorax brown, with three dark bands or stripes. Abdomen brownish-yellow ; legs brown, yellowish white underneath. Wings covered by a light pubescence, veins yellowish. Halteres pale. Antennæ of ♂ 26-jointed, very much longer than the body ; in ♀ the antennæ are 14-jointed, shorter than body. Third segment of oviduct white.

$$D. pini, \text{Deg.} = \begin{cases} \text{Tipula pini, Deg.} \\ \text{Cecid. pini, Mg.} \\ C. pini-maritimæ, Du. \\ C. pilosa, Bremi. \\ C. laterella, Zett. \end{cases}$$

The larvae of *pini* have rows of fleshy setiferous caruncles along the back, with two setiferous tubercles on the last segment. They live on *Pinus sylvestris*. This larva is figured by Perris, who evidently mistook the dorsal for the ventral surface, as was also done by Dufour. The cocoons are resinous structures on the pine-leaves. They appear to inhabit almost any species of pine.

The *imago* is dark brown to black ; antennæ yellowish, palpi tawny ; sides of the thorax and abdomen reddish-brown, becoming brown after death. Wings pellucid, veins dark, halteres light gray. The antennæ in the ♂ longer than the body. In the ♀ 13-jointed, about half the length of body, the joints four or five times the length of their petioles. Legs dusky, with white or silvery pubescence on the under surface. The whole insect may sometimes have a dirty white pubescence on it. The oviduct is short, with two small roundish valves, light brown to yellow ; ♂ organs brown.

D. callida, Wtz.

The larvae live in the seed-capsules of various poppies, and are said to be found in company with *Cecidomyia papaveris*, according to Walker. Verrall, however, only considers *Papaveris* a reputed British species.

The *imago* of this "Poppy Gnat" is tawny; the thorax has three dark brown stripes, pectus shining; antennæ brown, base yellow. Wings brown; veins also brown. Transverse veinlet joining the first longitudinal beyond its middle. Legs brown, moderately long. In the ♂ the antennæ are very long, nearly twice the length of the body, the double joints as long as their petioles. In ♀ antennæ are shorter than the body; joints and petioles of equal length. Oviduct short, and composed of two lamellæ. The wings have dark violet markings, which are especially characterized by two rows and a pointed spot.

D. centralis, Wtz. = *Cec. annulipes*, Mg.

The life history of this gnat seems uncertain; if it is the same as *Cecidomyia annulipes* of Meigen * it inhabits beech-trees, but the synonym seems doubtful.

Centralis is described by Schiner as follows: "Reddish-yellow thorax, with three chestnut-brown streaks; the hairs of the whole body pale reddish-yellow. Antennæ brown, much shorter than body; joints six times length of petioles, the end joint with bud-like protuberance. Legs whitish. Wings clear as glass, with three blue-violet cross rows and similar spots; fifth venation starting violet, bent down in a right angle to the hind margin; the third joining the edge rather behind the wing-point."

I believe Meigen's description of *annulipes* is the same as that given by Walker under *Centralis*, viz.: "♀ tawny, Antennæ brown, a little more than half the length of body; joints six times the length of their petioles. Thorax with three chestnut-brown stripes. Pectus blackish. Wings limpid, with three brown bands; veins brown; transverse veinlet situated before the middle of the sub-costal (first longitudinal vein), anal (third and fourth) and its second branch forming an almost right angle. Halteres white. Oviduct as long as the abdomen, with two somewhat rounded valves. Legs whitish, with black bands."†

* Syst. Beschr., vi., 1130, p. 268 ♀. Schiner evidently does not consider them the same species.

† Walker, Ins. Brit., viii., p. 115.

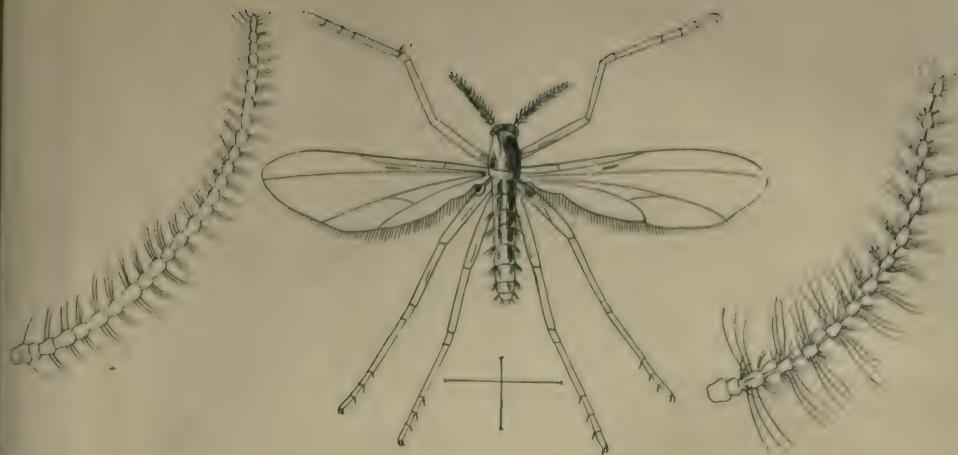


FIG. 4.

FIG. 1.

FIG. 5.



FIG. 6.

FIG. 2.

FIG. 7.

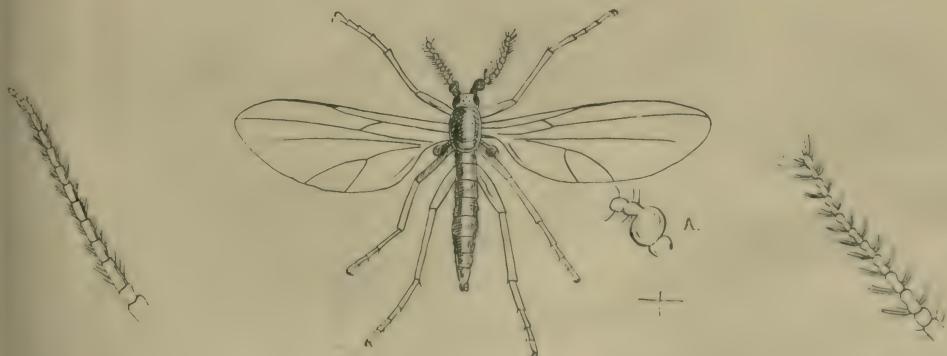
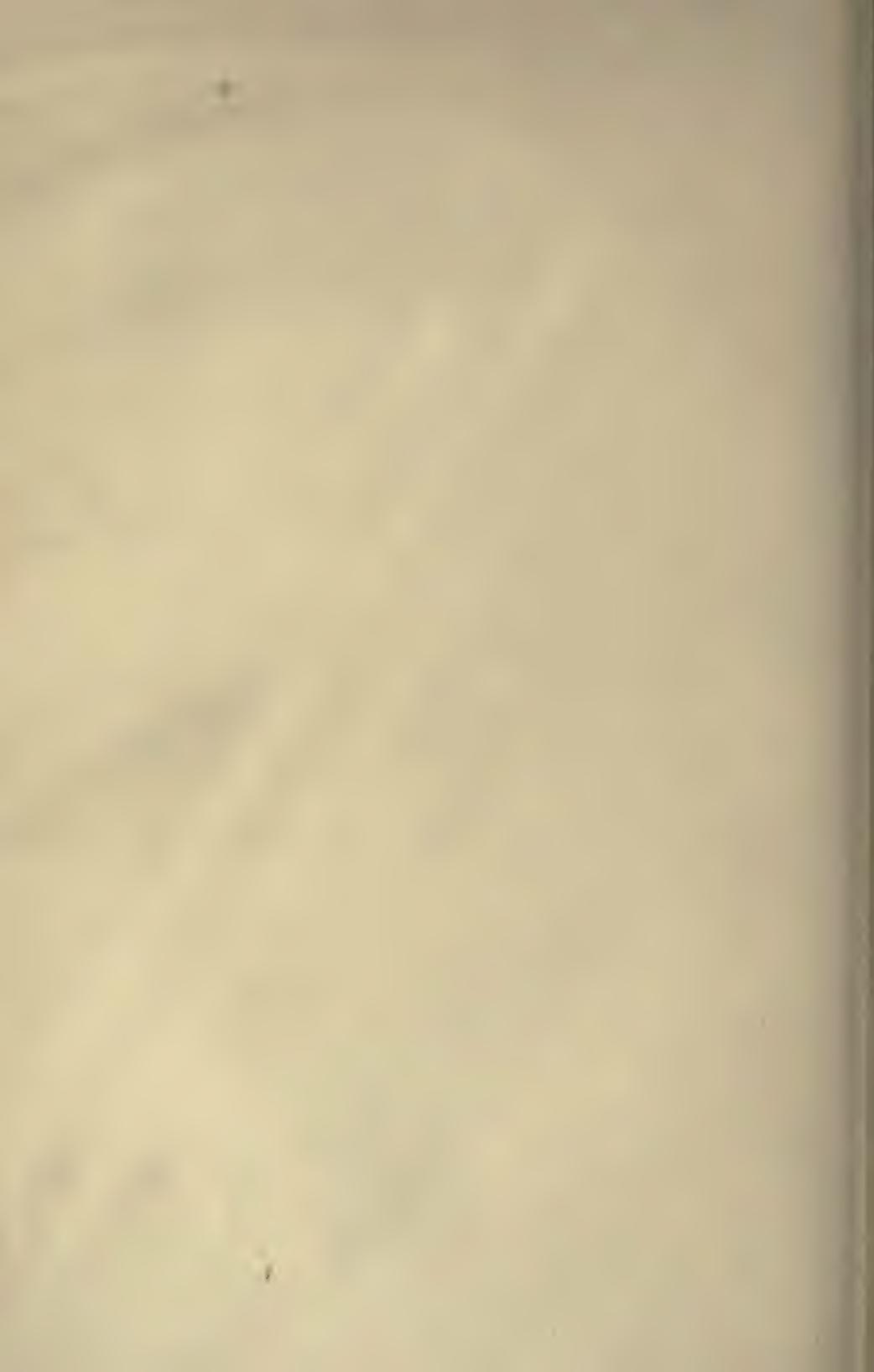


FIG. 8.

FIG. 3.

FIG. 9.

FIG. 1.—*Hormomyia fasciata*. FIG. 2.—*Lasioptera rubi*. FIG. 3.—*Micromyia globifer*; A., enlarged basal joint of antenna. FIG. 4.—Antenna of *H. fasciata*. FIG. 5.—Antenna of *Epidosis gracilis*. FIG. 6.—Antenna of *Campylomyia kaltnerata*. FIG. 7.—Antenna of *Diplosis buxi*. FIG. 8.—Antenna of *Asphondylia sarothamni*. FIG. 9.—Antenna of *Lestremia carnea*.



D. flava, Mg. = *Cec. hilarella*, Zett.

The ♂ yellow; with black head. Antennæ dark brown, 16-jointed, as long as the body; joints never longer than their petioles, the latter yellow, the joints are alternately longer and shorter. Wings opalescent; veins faint and yellowish; first longitudinal less than half length of wing; second longitudinal vein slightly curved; second branch of anal (3.4) curved obliquely to the hind border. Halteres pale. Legs long and slender; pale yellow. Length 1 lin.

The larvæ live in rosettes on the stalks of corn. (Die Larve soll nach Roser l. c. in Getreidehalmen leben.)

D. jacobæa, Lw.

The larvæ live in the flower-heads of *Senecio Jacobæa*.

SUB-GENUS.—*Hormomyia*, Lw.*H. Fagi*, Hartig.

This species, which is common all over Europe, is most abundant in Switzerland and in England. The galls in the former place seem to be of a pyramidal shape, in England they are horn-shaped; both upon the upper surface of beech-leaves (*Fagus sylvatica*). According to some accounts the galls drop off and the larvæ pupate in them.

Imago.—Dorsum blackish-brown, with three narrow stripes; abdomen flesh-coloured, with gray hairs. Antennæ of ♂ 24-jointed, petiolate, of ♀ shorter and sessile. Wings brownish, with gray hairs, but appear white against a dark background; base of second longitudinal vein hardly discernible; third longitudinal bent in front in a rectangular manner, lower branch only visible at base, upper hardly discernible, the fold almost looking like a vein, 2-2½ lin. (Hartig—Jahres-bericht, 1, p. 4, 641 (1839). *Pupa*, Fig. 5, Taf. i., vol. viii., Lin. Ent. Winnertz. *Palpi*, Figs. 22 and 23. *Wing*, Fig. 8, Taf. ii. *Antennæ*, Fig. 9, a, b, c and d, Taf. iii.

H. capreae, Wtz. = *C. capreae*, Hardy.

The larvæ of this species live in pustule-shaped galls on the leaves of *Salix caprea*, *aurita* and *oleifolia*, and pupate under fallen leaves, according to Winnertz.

The *imago* is dark reddish-yellow, with three dark stripes on the dorsum, of which often only the middle one exists in fragments. Antennæ shorter than body, 14-jointed, petiolate in ♂, sessile in ♀. Wings large, whitish with grayish-white hairs; second longitudinal vein ending in the extremity of the wing, its base very weak; third longitudinal vein bending in front in the form of a bow; ¾ to 1 lin.

H. Poæ, Bosc. = H. graminicola, Wtz.

The larvæ of this species form rough brown oval galls on *Poa nemoralis*, and pupate in these galls.

♂ Whitish-yellow. Pectus and metathorax dark brown. Antennæ grayish-brown, yellowish in places. Wings limpid; legs brown. Antennæ, 19-20-jointed; shorter than the body; the joints are twice the length of petiole. The abdomen is dark brown, the sutures being lighter, sometimes yellow.

♀ Abdomen tawny; the posterior borders of the segments have brown bands on them. Antennæ, 19-jointed and half the length of body. Joints much longer than the petioles. Tip of oviduct expanded, no valves.

H. piligera, Lw. = annulipes, Hartig., Wtz.

The hairy galls on the leaves of *Fagus sylvatica* are the home of the larvæ of this "gnat."

♂ Dark brown; palpi yellowish-brown; antennæ longer than body, joints longer than petioles; dark brown. Sides of thorax and abdomen flesh-coloured.

♀ Antennæ as long as head and thorax; joints not petiolate. Oviduct long, yellow, no valves.

The joints of the antennæ are from 17 to 20 in number.

H. fasciata, Mg.

♀ Brown; antennæ 14-jointed. Thorax yellowish-brown; three dark brown stripes and a black spot on each side behind. Pectus dark brown. Abdomen yellowish-white, with a black shining band on the posterior margin of the first to seventh segment. Pl. ii. (1).

H. Ptarmicæ, Vallot = H. floricola, Wtz.

One often notices the flowers of *Achillea Ptarmica* deformed and stunted; this is generally due to the attack of the larvæ of this gnat, which live in the deformed flower-heads.

♂ Black; dark pubescence; antennæ brown, 18-jointed. Antennæ shorter than body, joints twice length of petioles. Sides of thorax brownish-red to pink. Wings broad and milky. Abdomen brownish-yellow. Legs dusky brown, silvery hairs beneath.

♀ Antennæ only half length of body; joints five to six times the length of their petioles. Abdomen flesh-coloured. Legs have white pubescence beneath. Oviduct elongated. Length 1 lin. I find this first mentioned in "The Memoirs of the Academy of Science, Dijon," for 1849.

H. millefolii, Lw. = *C. achilleæ*, Inchbald.

The larvæ inhabit calyx-shaped galls in the axils of the leaves of *Achillea millefolium*.

Besides these there are four other British species, viz. :

H. abrotani, Traill.

H. corni, Gir., the larvæ in galls on *Cornus sanguinea*. *Vide* Kaltenbach (18), p. 295.

H. Fischeri, Fefld., form swellings on the stems of *Carex pilosa*. *Vide* (18), p. 730.

H. juniperina, L. =
$$\left\{ \begin{array}{l} \text{Tipula juniperina, Linné.} \\ \text{Cecid. , , Deg.} \\ \text{Oligostrophus juniperina, Lat.} \\ \text{Lasioptera , , Mg.} \\ \text{Cecid. flavimaculata, Zett.} \end{array} \right.$$

The larvæ live in spindle-shaped galls on the upper twigs of the juniper, and metamorphose in the galls. *Vide* Bremi (1), p. 24, and Schiner (7), p. 399.

SUB-GENUS.—*Dirrhiza*, Lw.

Schiner unites *Dirrhiza*, Lw., with *Epidosis*, from which it only differs in this : that the transverse veinlet is plain, and the antennæ in ♀ sessile, and in ♂ only short petioles.

D. rhodophila, Hardy.

This small sub-genus is represented in England by one species only, viz., *D. rhodophila*, described by Hardy.* Bergenstamm says, "Lebenweise unbekannt." Found only in England ; another species *laterita* is found in Europe, habits likewise unknown.

♀ *Imago*.—Pale ; small ; elegant ; head black ; thorax brown above, with three lines of "griscous" hairs ; scutellum and metathorax yellow or pinkish ; abdomen short, light yellow ; legs long and slender, yellowish. Wings wide, with purple iridescence, finely pubescent and fringed. Costal and first longitudinal vein distinct. Antennæ black, 18-jointed ; first and second joints thick and cup-shaped, gradually getting smaller, last joint ovate, short verticillate hairs. Halteres white. Length $\frac{1}{2}$ lin.

SUB-GENUS.—*Epidosis*, Lw.

Walker describes several of this sub-genus, but they are not now

* Ann. of Nat. Hist., vi. 182 (Larvæ possibly form galls on the rose).

included in the British Fauna. The only true British species is *E. longipes*. Pl. i. (3).

E. longipes, Lw.*

Löw describes the ♀, and Walker gives a good figure. Mr. Haliday took it in Tullamore Park, Ireland. The antennæ are about twice the length of body, and 16-jointed in the ♂. Wings large, much longer than body. Legs long and slender. Pl. i. (3).

E. defecta, Lw.

This is a reputed British species. The larvæ live in decaying beechwood.

The *imago* is pale yellow, the extremities of pincers black. Antennæ pale brown, 15-jointed, with whorls of very long hairs. The last joints of tarsi white. Wings long and narrow, with pale gray hairs and pale brown veins; slightly iridescent. Antennæ of ♀ 13-jointed. Ovipositor long, no lamellæ. Colours fade at death.

SUB-GENUS.—*Asynapta*, Lw.

Of the sub-genus *Asynapta*, Taschenberg remarks that it may be divided into two groups. Pl. i. (4).

First group (*Asynapta*, Rondani), lengthened neck and large palpi, with four very long joints.

Second group (*Winnertzia*, Rond.), unlengthened scutum, smaller palpi, with four only moderately-lengthened joints.

Asynapta lugubris, Lw.†

The larvæ of this gnat live in decaying beechwood, according to Schiner. Taschenberg describes the ♀ as piercing the budding leaves of the plum to lay her eggs therein, and the larvæ as inhabiting lemon-shaped galls in June. They pupate in August.

Imago.—Scutum black-brown and shiny; sides dark yellow; abdomen yellow with whitish-gray hairs. Palpi very hairy. Antennæ 14-jointed, joints double the length of petioles. Legs yellow. Wings blackish with dark hairs; first longitudinal vein apparently distant from front edge; second longitudinal vein rising steeply, finishing in the tip of the wing. Antennæ in ♀ short; ovipositor long, two long lamellæ. Parasites attacking this species: *Pteromalus piscipalpis* and *Eurytoma Amerlingi*.

* Vide Löw (2) D.B., 1850, iv., p. 38.

† Ins. Brit., vol. iii., p. 129.

Winnertzia tenella, Wlk.

This seems only to have been described by Walker,* and is recorded from England.

Walker describes the *imago* as being testaceous, with black antennæ. Wings limpid, being narrow towards the base; veins testaceous; first longitudinal vein about $\frac{1}{3}$ length of wing; second longitudinal vein curved towards the tip of the wing, parallel to the border, ending near the tip; first branch of third longitudinal obsolete; second curved abruptly and slightly obliquely to the border. Antennæ in ♂ 16-jointed, in ♀ 12-jointed. Oviduct short.

Life history unknown.

SUB-GENUS.—*Asphondylia*, Lw.

Four species of the sub-genus are recorded in England. Walker describes several others, but they are not considered authentic.

A. sarothamni, Lw.

The larvæ live in galls produced on the twigs of *Sarothamnus scorpiarius*. The galls are small bud-like structures, and in these the metamorphosis takes place. The perfect insect is dark gray, with tawny head, scutellum, pectus and metathorax. Wings brownish; antennæ 15-jointed in ♂, 14-jointed in ♀. The ovipositor is brownish-yellow and very long in this species. The oviduct, pupa and palpus have been figured by Winnertz.† This species is much smaller than *Ulicis*, and the ovipositor much longer. Pl. ii. (8).

A. ulicis, Traill.

♂ and ♀ brownish-black, paler on the breast, sides and bases of humerus; face and palpi yellowish; abdomen shining-brown, sides paler; antennæ 13-jointed, not so long as body; the joints following the two basal ones decrease in length until the last two, which are stout and form a knot. Halteres and legs yellowish, varying to brown; coxae grayish. ♂ genitalia yellow, ♀ orange. Transverse veinlet indistinct; wings iridescent, hairy. The larvæ form galls resembling flower buds, but larger on *Ulex Europaeus*. The galls are lined by a gray pubescence, on which the larvæ feed.

A. genistæ, Lw.‡

The larvæ form green galls on *Genista Germanica*, and metamorphose there. This species is larger than the above.

* Vide Schiner, *Die Fliegen*, vol. ii., p. 406.

† Lin. Ent. Tom. 8, Taf. 1, figs. 6, 15 and 20.

‡ Vide Ann. Ent. Soc. Fr., 1870, p. 177.

A. pimpinellæ, F.

The larvæ live in galls on *Pimpinellæ saxifraga*. They pupate in the earth.

SECTION 2.—LESTREMINÆ.

SUB-GENUS.—*Campylomyza*, Mg.

The life histories of this sub-genus are not well known—many live in decayed wood. They are common insects in hedges, woods and windows, especially those of hot-houses. Pl. i. (6).

C. flavipes, Mg., = *C. pallipes*, Zett.*

Black, shining, with brown abdomen. Wings limpid, nerves dark; halteres pale; legs testaceous; length $\frac{1}{2}$ lin. Found amongst grass in the autumn.

C. bicolor, Mg..

Very like the former. Black; fuscous abdomen; wings limpid; distance between tip of first longitudinal vein and transverse veinlet is four times the length of the latter; halteres whitish; legs pale; length $\frac{1}{2}$ lin. Appears in the autumn.

C. aceris, Mg.

Shining black; abdomen piceous; wings limpid; halteres, veins of wings and legs testaceous. Length $\frac{1}{3}$ lin.

C. halterata, Zett. = *C. atra*, Wlk.

Black, piceous legs and abdomen. Halteres white;† wings limpid, gray, dark pubescence; length 1 lin. Habits unknown. Pl. ii. (6).

A fossil, *Campylomyza* (*C. grandæva*), has been found in the Purbeck beds of the Dorsetshire Coast.

SUB-GENUS.—*Micromyia*, Rud.*M. globifera*, Hal. = *Campylomyza globifera*, Wlk. et Hal.

Imago.—Deep black, not glossy. Antennæ not so long as the thorax, 11-jointed, fuscous; first two joints black; second joint very large in ♂. Wings white, hyaline; costal and two anterior veins light brown, posterior veins colourless; halteres and legs dingy yellow—abdomen long; posterior segments in ♀ not so much attenuated as usual; eighth and ninth largely exserted, dingy yellow; terminal

* Dipt. Scan., vol. ix., p. 3672.

† According to Walker they are piceous.

tentacles more dusky, 2-jointed; second joint smaller, orbiculate; beneath them a compressed obtuse process nearly as long; forceps of ♂ unguiculate. Found on short grass at Holywood, etc. (Haliday); length ♂ $\frac{3}{4}$ lin., ♀ $\frac{5}{6}$ lin. Pl. ii. (3).

SUB-GENUS.—*Catocha*, Hal.

C. latipes, Hal. = *Macrostyla latipes*, Wtz.

Black, head small, round; eyes lunate; ocelli three, unequal; abdomen eight segments; dirty brownish-yellow, with dark incisions; antennæ in ♂ 16-jointed; 10-jointed in ♀, shorter than in ♂, joints oval, except three and ten, which are elongated; antennæ brown, dark brown at the base; thorax shining, oval, convex; scutellum large, semilunate; wings broad, obtuse, pubescent, broad fringe on posterior border. The first longitudinal vein ends at about half-length of wing, second longitudinal ending hardly in front of tip of wing; cross vein small; third longitudinal forked; fourth and fifth simple ending at the border; halteres brown; legs brownish-yellow; last two or three tarsal joints dilated, one pulvillus (Fig. 6). When alive the *imago* is metallic-blue, with brick-red appearance under the wings. This colouring soon fades in death. Bergenstamm says “Lebensweise unbekannt.” Pl. i. (5).

SUB-GENUS.—*Lestremia*.

This sub-genus is interesting as connecting the Cecidomyidæ with the Mycetophilidæ. The veins of the wing resemble *Sciara*, while the antennæ and legs are truly Cecid in character. Pl. i. (7).

$$L. leucophaea, Mg. = \begin{cases} Sciara leucophaea, Mg. \\ Tipula juniperina, Fab. \\ Chironomus juniperina, Fab. \\ L. cinerea, Macq. \end{cases}$$

This species is found in larch groves; the habits are unknown. Antennæ of ♂ 15-16-jointed. Scutum brown above, yellow at sides. Abdomen dirty brownish-yellow. Legs pale yellow; tarsi dark. Antennæ brownish; long petioles. Wings transparent; small hairs, with brown veins. First and second longitudinal veins parallel and near each other; second longitudinal ending far from the extremity of wing; fork of fourth longitudinal vein very long; that of third longitudinal still longer; upper tooth straight; under tooth bending towards posterior edge.

L. carnea, H. Lw. = *Cecidogona carnea*.

This species has white halteres ; antennæ black. Wings with pale veins ; black near costa. Abdomen of ♀ testaceous, also legs (in both sexes) ; tarsi brown. Habits and metamorphosis likewise unknown. Pl. ii. (9).

A third species is recorded in Verrall's list as British, viz., *L. cinerea*, Meg., and also described in Walker and Blanchard.* Bergenstamm and Löw say it is synonymous with *L. leucophæa*, Mg.

GENUS.—*Lasioptera*.

The insects in this genus are distinct from the ones we have been discussing. There are three longitudinal veins, although this is not easily seen at first ; the first being very faint and running with the second close to the costa. Pl. i. (10). The wings are short and broad. Antennæ 16-26-jointed ; the joints are sessile and sub-globular. Proboscis very short. They are small and delicate insects. Ocelli absent. Eyes lunate. Tarsi very long ; metatarsus often very short.

In their habits they resemble the *Cecidomyidae*, infesting plants much in the same way. The larvæ are much the same as in the Cecids, having the same peculiar reddish hue and curious "breast-bone."

Clinorhyncha is considered by some as a sub-genus of *Lasioptera*, by others as a distinct genus, the chief difference from *Lasioptera* being the prolongation of the mouth into a rostrum. This sub-genus is not recorded from England, however.

There only appear to be two verified British species of *Lasioptera* ; three others recorded in Verrall's list seem to be doubtful, and there are also two reputed forms.

$$L. rubi, \text{ Schrk. et Heeger.} \dagger = \begin{cases} L. picta, \text{ Mg.} \\ L. argyrosticta, \text{ Mg.} \\ L. fusca, \text{ Vallot.} \end{cases}$$

The larvæ live in excrescences on the stems of various *Rubi* and metamorphose in the galls. They appear in May.

Imago.—Brownish-black ; antennæ of ♂ black, shorter than the head, 20-21-jointed. Palpi yellow ; head yellow and brown. Thorax deep black ; "schildchen" white. Abdomen and ♂ genitalia covered by white hairs. Legs also covered by silvery hairs. Wings clear ; costa thick and dark, in the middle a white spot, root of costa

* *Histoire Naturelle des Insectes*, iii., 1840, p. 574.

† Lin. Ent., vol. viii., p. 306., pl. iv., figs. 11 and 14.

so pale. ♀ resembles ♂, only the antennæ are 21-22-jointed. Ovipositor yellowish-white; long; no lamellæ. After death the colours turn browner and the white hairs less silvery. Pl. ii. (2).

L. albipennis, Mg.

The larvæ live between the scales of the galls produced by *C. rosaria* on *Salix alba*.

Imago.—Deep black; wings limpid and hairy, gray at the tips, with veins and cilia black; a small white spot is present at the tip of the first longitudinal vein, on the costa. Legs piceous, stout moderately long.*

L. stygia, Mg.

This is a brownish species, yellowish on the ventral surface; black antennæ; densely pubescent dark-gray wings. Legs long and stout, white in certain lights. Metatarsus longer than any of the following joints. Life history unknown.

L. obfuscata, Mg. = *Cecidomyia obfuscata*, Walker (p. 86).

Testaceous; black head and antennæ. Thorax brownish. Legs as in species above, but with brown bands on the tibiæ and tarsi. Walker says the larvæ have been observed by Kaltenbach to feed on the thistle.

L. fuliginosa, Steph.

Habits unknown. Recorded in Stephen's "Illustrations of British Entomology," 1846 (p. 42, Fig. 4).

L. pusilla, Mg., and *berberina*, Schrk., are two reputed species in the English fauna.

The family just passed over in this chapter is seen to be one of great importance, on account of its containing so many insects that are injurious to plant life, especially two (*C. destructor* and *D. tritici*); many of the others are injurious in a less extent. Considering, then, the destruction caused by these small and insignificant-looking flies, it is strange that they have passed unnoticed so much in England; scarcely any local lists contain more than one or two species out of the great number already recorded in Britain. Dale, for instance, only records *C. tritici* from W. Cornwall; only three or four are

* Sys. Besch. der b.e.z., Insekten, A. 1818, T. i., p. 89, pl. iii., fig. 5.

mentioned in the list of Diptera found at Hastings, etc. Yet with a little trouble a great many may be captured. I have taken as many as ten different species myself on the windows of a single room on one wet afternoon. With careful collecting a large number may be met with, and many new species to the English fauna are sure to be captured. Verrall gives a long list of reputed species, none of which have been dealt with here; many of these are recorded and described in Walker's "Diptera Insecta Britannica," but until further evidence is found they will be left out of the British list; by degrees, no doubt, they will all find their way back again, but at the present rate it will take many years. Amongst those who have done most for this family must be mentioned Winnertz, whose "Monographie der Gallmücken" in the *Linnæa Entomologica* is of so much value. Other works of importance on this family are quoted below:

Literature on the Cecidomyidae:

1. Beiträge zu einer Monographie der Gallmücken. Denkschr. allg. sch. Ges. f. d. ges. Nat. Neuenburg, T. ix., 1847.—Bremi.
2. Dipterologische Beiträge, 1850. Posen, T. iv.—Löw.
3. Ueber den Bernstein und die Bernstein fauna.—Löw.
4. Ueber die Entwicklung der Cecidomyienlarve aus dem Pseudovum. Archiv. f. Nat., 1865, T. xv.—Mecznikoff.
5. Systematische Beschreibung der bekannten Europäischen zweiflügeligen Insekten. Aachen, 1818-1838.—Meigen.
6. Monograph of Diptera of North America.—Osten-Sacken.
7. Fauna Austriaca, Diptera.—Schiner (Wien, 1864, T. ii.).
8. Practische Insekten-Kunde. Leipzig.—Taschenberg.
9. Insecta Britannica Diptera, vol. iii.—Walker.
10. Linnæa Entomologica, 1853, T. viii.—Winnertz.
11. Beschreibung einiger neuen Gattungen aus der Ordnung der Zweiflügler. Stett. ent. Zeitg., 1846, T. vii.
12. Dipterologisches, *ibid.*, 1852, T. xiii.
13. Synopsis Cecidomyidarum. Vorgelegt in der Versammlung, v. 5, Jan., 1876.—Bergenstamm und Löw.
14. Hist. Nat. des Insectes Dipteres. Paris, 1834.—Macquart.
15. Naturgeschichte der Insecten, 1834.—Bouché.
16. Fauna Boica. Landshut, 1803, T. iii.—Schrank.
17. Beiträge zur Kenntniss der Insectenlarven. Stett. ent. Zeitg., 1847, T. viii.—Bouché.
18. Die Pflanzenfeinde aus der Klasse der Insekten. Stuttgart, 1874.

19. The "Hessian Fly" and "Wheat Midge."—Miss Ormerod : Reports.
20. Die Pflanzengallen Norddeutschlands und ihre Erzeuger.—Rudow, 1875.
21. Ueber die Gallen und andere durch Insekten hervorgebrachte Pflanzendendeformationen. Stett. ent. Zeitg., 1861, T. xxii., p. 405.—O. Sacken.
22. British Entomology, 1872.—Curtis.

CHAPTER V.

THE MYCETOPOHILIDÆ, OR "FUNGUS GNATS."

THE *Mycetophilidæ* are a large family of gnats related to the *Cecidomyidæ*, and formerly contained two genera (*Catocha* and *Lestremia*), which are now placed in the latter family, although both these genera show affinities to the *Sciarinæ*.

The following names are synonymous with the family—

Mycetophilinae et *Sciarinæ*, Zett.
Mycetophilidæ =
$$\begin{cases} \text{Mycetophilites, Newman.} \\ \text{Tip. Mycetophilides, Westwood.} \\ \text{Tip. Fungicola, Mg.} \end{cases}$$

On the one hand we see the family is closely connected to the *Cecidomyidæ* by *Lestremia*, etc., and on the other to the *Bibionidæ* by the genus *Anarete*, which was for a long time retained in the family we are dealing with now. Besides these two connections there are also close affinities to the "Fleas,"* as exemplified by the genus *Mycetophila*, and, according to Walker, especially by the species *M. nigra*, a northern species, but from the description of it given by Zetterstedt in his "Insecta Lapponica" (p. 860), I fail to see any resemblance unless in the appearance of the legs, but even there it is very slight.

These "fungus gnats" also appear to be connected to the *Tipulidæ* through the genus *Dixa*, which for a long time has been hovering from family to family, and at last has been satisfactorily disposed of by raising it to a family of its own in the neighbourhood of the *Ptychopteridae*.

In many respects the problematical *dixa* resembled the genus *Bolitophila*. It was included in the family under consideration by Meigen and Zetterstedt, but is now definitely separated from it.

At present the *Mycetophilidæ* seem to be little understood,

* Walker's Ins. Brit., viii., p. 6.

although some good work has been done recently on the Continent, especially in Russia. Verrall has not worked this family yet, so the British list is far from complete; nevertheless, forty genera and about 160 species are recorded, and many reputed. Many of the species described by Walker must be eradicated, as in all the other families, with the exception of the *Dolichopodidae*.

Few insects are more abundant than the "fungus gnat," but their appearance is so extremely erratic that one may go a whole year and find none, then hundreds may suddenly appear. They seem to have been first discovered in the Purbeckian Period, and many genera have been obtained from these Mesozoic beds, including *Platyura*, *Sciophila* and *Macrocerata* (*vide* Brodie's "Fossil Insects"), from the lower Purbecks of Wilts and Hants. From the Solenhofen States Germar* describes a *Sciara*, *S. prisca*, and one also by Giebel.† The three genera figured by Brodie are given by Giebel as new genera, viz., *Adonia*, *Sama*, and *Thimna* respectively. Besides these Westwood also figures an obscure species referred to the extinct genus *Zhiras*. When we come to the Tertiary Period we find large numbers of these "gnats," which are represented by the genera *Zygoneura*, *Mycetophila*, *Leia*, *Sciara*, *Sciophila*, *Sciobia*, *Platyura*, *Macrocerata*, *Heterotricha*, *Dianepsia*, *Mycetobia*, *Aclada*, *Diadocidia*, *Boletophila*, *Cordyla*, *Brachypeza*, *Trichonta*, *Boletina*, *Gnoriste*,‡ and an extinct genus *Sackenia*; more than 280 species have been found, and from widely separate areas, mostly from the ambers of the Continent and from America, the rock species being few compared to the amber.

Their range in *time* is seen to be fairly wide, as also is their distribution in *space*, for the fungus gnats appear in most parts of the globe, from Scandinavia into the tropics. They pass into the Arctic circle, cold seeming to have no influence on them. For some time I kept the pupæ of some *Mycetophilidæ* in a temperature of 30°, the effects of the cold only retarding the development a few days, and in no ways injuring the species. In England several species may be taken in the middle of winter.

The habitat of the imagos is generally amongst the grass and in hothouses, where they may sometimes be taken in great numbers on the glass. They also often appear in great numbers on windows in houses, and I have noticed this especially during the autumn. One of the most notable points in the habits of these gnats is the peculiar

* Germar, 'Nova Acta,' Ac. of Leo. Ch. of Austria, 1839, xix. 2, S, 189-222.

† Fauna der Vorwelt. Giebel.

‡ Edin. New Phil. Journal, 1829, pl. vi., figs. 8, 9.

method of leaping, resembling the "hop" of a flea, the hind legs being adapted to this use. When found out of doors, many (*Mycetophila*) may be taken in damp ground, and others in plenty near and around fungi, especially when they are somewhat decayed. Many are (*Sciophila*) short lived; others (*Mycetophila*) hibernate, and appear in the early spring, and according to Heeger, "copulate after a few days, generally in the evening. After six or ten days the female, if the weather is moist and rainy, lays its eggs on the fungi growing on old horse-chestnuts, singly, twenty or thirty on the same fungus. The larvæ hatch after eight or ten days."

The "fungus gnats" have not been studied in the same way the Cecids have, and our knowledge of them is not very satisfactory. Recently some good work has been done on the Continent, especially in Russia, by Dziedzicki, whose "Monograph of European *Phronie*"* is of great value. The small size and the absence of damage done by the larvæ has hindered their study in such detail as has been done in the Cecidomyiidae. Some few are certainly injurious, as the species that live upon the "Mushroom," whole frames of this edible fungus being destroyed by these larvæ; but the amount of damage done is small compared to the amount of good which these maggots do in destroying fungi.

The ♀ lays her eggs generally on the under surface of the pileus (*Mycetophila*), walking about over the surface first to find a suitable place, then depositing the ova singly. Others (*Sciara*) lay their eggs in decaying vegetable matter; they may, as in some of this genus (*Sciara*) be laid in long strings. The eggs are white and cylindrical, and vary from $\frac{1}{8}$ to $\frac{1}{4}$ of a line in length.

The larvæ hatch after eight or ten days. The account of the larvæ is mainly taken from a paper kindly sent me by C. R. Osten-Sacken,† which gives a concise and full description of the structure and habits of *Mycetophila* larvæ. In this paper he gives the following characters of the larvæ:

"A distinct horny head; a fleshy labrum, encased in a horny frame; horny flat lamelliform mandibles, indented on the inside; maxillæ with a large coriaceous inner lobe, and a horny outside piece, with a circular excision at the tip; labrum horny, small and almost rudimentary; body fleshy, with eight pairs of stigmata."

The antennæ are mostly rudimentary (*Mycetophila*, *Sciara*) and spring from a pit on each side of the mouth; they are often only "fleshy swellings," but in some (*Bolitophila*) they are distinctly

* Hor. Ent. Rossland, xxiii.

† Characters of the larvæ of *Mycetophilidae*.

jointed ; in this the first joint is fleshy, and divided into two by a horny ring ; second joint cylindrical and horny ; third joint short, often bearing a bristle.

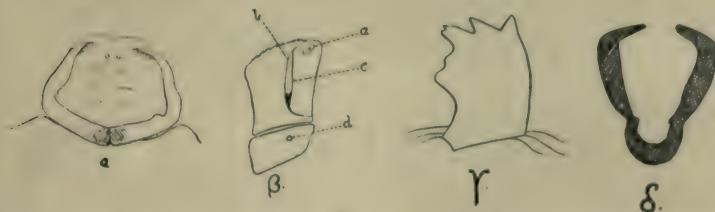


FIG. 13.—Mouth parts of *Mycetid* larva.— α . Labrum ; β . Maxilla ; γ . Mandible ; δ . Labium.

Ocelli may be present, and are figured by Osten-Sacken in his paper as a small, pellucid convex spot below the antennæ in *Mycetophila* larvæ.

The mouth parts of the larvæ are typical and normal, consisting of *labrum*, *mandibles*, *maxillæ*, and *upper lip*.

The *labrum*, Fig. 13 (α), is fleshy and encased in a horny frame ; its function, according to Osten-Sacken, "seems to be, principally, to shut the oral orifice, and perhaps to press on the mandibles and maxillæ during the process of mastication."

The *maxillæ*, Fig. 13 (β), are horny and serrated on the inside.

The *maxillæ* consist of two pieces : a triangular *cardinal piece* (a) and a *stirps* composed of two distinct pieces, an inner and outer (b) and (a) ; the inner one has a serrated lobe on the inside, showing much analogy of structure in all the larvæ (*Sciara* has six or seven indentations, *Mycetophila* ten or eleven). A rudimentary *palpus* is present in some forms (*Sciophila*) ; it is 2-jointed. In other genera it is very rudimentary.

The *upper lip*, Fig. 13 (δ), little developed. Usually as a V-shaped, horny piece between the maxillæ. This may have some function in connection with the cocoon spinning of the larvæ.

The *Mandibles*, Fig. 13 (γ), are horny lamels serrated on the inside, and are compressed between labrum and maxillæ.

The general form of the body is sub-cylindrical, elongated, and fleshy, white or yellowish, and composed of twelve segments. In many it is serpentiform (*Sciophila*), some stout (*Bolitophila*). The skin is smooth ; hairs on the ventral surface. Eight pairs of stigmata are present : one pair on the first thoracic and seven on the first seven abdominal segments. The larvæ are generally transparent,

the alimentary canal being plainly seen through the integuments. On the ventral surface organs of locomotion seem to be represented by slight swellings armed with bristles.

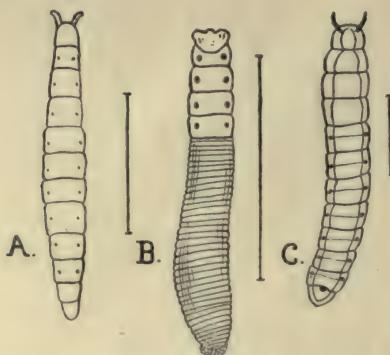


FIG. 14.—A. Larva of *Sciophila*; B. Larva of *Ceroplatys*; C. of *Sciara*.

The habits of the larvae are interesting. They are all gregarious. They all, with the exception of *Sciara*, seem to live in fungi. *Sciara* prefers vegetable mould and under the bark of trees for its home. The larvæ, according to various observations, appear to moult several times before they pupate. The *Sciophila* larvæ do not live *inside* fungi, but seem to prefer to crawl about on the outer surface, on the under side of the pileus, which they cover with threads. This web-formation is a very common feature in the larvæ of this family; a coarse webbing is formed over the surface or under side of the pileus, and in and under this the larvæ live. The larvæ forms a slimy tract where it crawls along. Perhaps the most interesting are those of *Sciara*, known as the "Army Worm."* They differ from other Mycetid larvæ by the absence of any bristles on the ventral surface, by the structure of their trophi and by their habits, nearly all living in large numbers under the bark of trees and in mould. At certain times these larvæ seem to migrate, for what purpose we do not know. They form columns twelve to fourteen feet in length, two or three inches broad and half an inch thick, containing countless numbers as close together as they can be packed. These processions are often seen in woods on the Continent, but what they are for or what they mean we cannot tell; as the larvæ are always full grown it cannot be for feeding purposes. It is this habit that has given them the name of "Army Worms." Some larvæ of this family are noted for a

* *Heer-wurm* is a better term, as so many larvæ which are gregarious are called "Army Worms."

curious structure formed of their own excrements, and carried on their backs, one such structure, resembling an *Ancylus*-shell. This has been observed by Perris in the larvæ of *Mycetophila scatophora*, and by Brauer in a species from Brazil. The larvæ, as a rule, spin a cocoon, but this is not always the case. *Bolitophila*, according to Dufour, has no cocoon; neither have certain *Mycetophila*. Others (*Sciara fuscipes*) have an earthy cocoon. The general rule, however, is that some kind of case is formed for the pupæ, which are found, as a rule, in fungi.* Some species of *Sciara* are also met with in cow-dung. The pupa (Fig. 15) is smooth, the angles being rounded; not sharp, as in the *Tipulidæ*. (The pupæ of *Sciara* are somewhat different, and strongly resemble those of the *Cecidomyia*.) The larval skin is not retained in this stage, as is done in many cases. The legs are applied to the breast and venter; the antennæ bent round the eyes, and their remaining portion between the legs and wings. In



FIG. 15.—Pupa of *Sciara*.

Sciara they may be expanded into a tooth at the base. In the same genus the prothoracic stigmata is placed on an elevation, which may extend into a horn. An air-tube may be seen entering it. Stigmata on abdomen plainly marked.

There are certain interesting points about the larvæ of *Mycetophilidæ*. One, is their curious habit of congregating into large bodies for migration; the other the brilliant luminous nature of certain larvæ in this family. The former we shall deal with when we go more fully into the genus *Sciara*, whilst now we will look at the remarkable phenomenon of luminosity shown by certain species included here. The cases of larvæ emitting a brilliant light are few in the Diptera. This phosphorescent character has been observed in

* Mr. Dale tells me "some larvæ spin a web on the outside of a fungus, and turn into pupæ somewhat after the manner of the small Eggar Moth (*A. lanestris*)."
This would be probably in the genus *Sciophila*.

the larvæ of *Chironomus* by Osten-Sacken,* in *Culex* by Pallas,† as long ago as 1782, and also in the larvæ of *Tipula oleracea* by Main.‡ These are the only records of any importance I can find. But in the *Mycetophilidæ* this phosphorescent character has been more fully observed. It was first noticed by Wahlberg,§ who, whilst studying the transformations of *Ceroplatus sesioides*, saw a bright light emitted by the larva and pupa, but not by the perfect insect. More recently some interesting papers have appeared in the *Entomologist's Monthly Magazine*|| by Hudson and Osten-Sacken. These luminous larvæ, described by Hudson, came from New Zealand. According to one of the best authorities, Osten-Sacken, they were the larvæ of *Sciophila*, certainly those of one of the *Mycetophilidæ*. The vividness of the light produced is best described in Mr. Hudson's own words: "The light from a single individual kept in a caterpillar cage may be seen streaming out of the ventilators at a distance of several feet." He describes it as coming from a gelatinous knob at the posterior extremity of the larva. Those who are interested in phosphorescent insects should read "Les Insectes Phosphorescents," Henri Gadeau de Kerville. Rouen, 1887.

Internal Anatomy of Ceroplatus¶ and Mycetophila.

The alimentary canal has two *salivary glands* opening into its proximal end, close to the mouth. Each gland is a slender, single tube, one on each side of the canal. In *Mycetophila* these glands are composed of large secreting cells with a dark nucleus. The duct of the gland is very fine, and is a simple tubular structure, the cells being more regular and clearer than those of the glandular part. The mouth opens into an *œsophagus*, which is short in *Ceroplatus*, but of moderate length in *Mycetophila*. The *crop* is oblong, with simple walls and with a small tubular neck in *Ceroplatus*. In the *Mycetophila* I examined there seemed only a slight constriction between the *œsophagus* and *crop*. The *Chylific ventricle* is long and cylindrical, and commences from two lateral conical, sack-like *caeca*. These two *caeca* I was unable to find in the flies I examined, but Dufour found them in *Ceroplatus*. There are four *hepatic caeca*, which open into the base of the *chylific ventricle*. The *intestine* is small and the walls appear to be smooth, ending in a somewhat

* *Ent. Mo. Mag.*, 1878, xv., p. 43.

† Kleine Notizen in den neuen Nordischen Beiträgen, 1782, t. iv., p. 396.

‡ *Mag. Nat. Hist.*, 1837, p. 549.

§ *Act. Holm.*, 1838, and *Stett. Ent. Zeit.*, 1849 (trans.).

|| *Ent. Mo. Mag.*, vol. xxiii., pp. 99, 133-230.

¶ Dufour, *Anns. des Sc. Nat. T. xi.*, 1839, pp. 193-213, pl. 5.

swollen part—the *rectum*. I failed to find any traces of *Malpighian tubules* in *Mycetophilæ*.

The *Nervous System* is composed of nine ganglia. Dufour says they are distributed as follows: one in head, two in thorax, and six in abdomen. In the myctid I examined this was certainly not the case. There are certainly two cerebral ganglia, two thoracic, and only five in the abdomen. This is the normal number for the *Fungicole*. Whether *Ceroptatus* is abnormal in having ten, or whether Dufour miscalculated the cerebral ganglia I have not been able to make out, as I have not had any live *Ceroptati* to examine.

The *Respiratory System*.—There are eight pairs of stigmata, two thoracic and six abdominal, from which proceed delicate tracheæ. I have been unable to make out their distribution. The ♀ sexual organs are composed of two long and rugose glandular ovaries, opening into a long neck and passing into an oviduct, which can be extended by the ♀.

Internal Anatomy of Larvæ.

The mouth parts of the larva consist of the following parts: A fleshy labrum in a horny frame; a pair of horny, serrated mandibles; a pair of maxillæ and an upper lip (Fig. 14). Dufour, in his description of *Ceroptatus*, figures two large eyes in the larva. These are wrongly described, they only being the bases of the antennæ. Into the mouth open two *salivary glands*; these are long, tubular structures, often as long as the body; but in one species I examined (*Sciophila*?) they were not so long. The walls of the glands seem to be simple. No doubt these have some function in the web-spinning of the larvæ, and possibly manufacture the fluid that forms the thread for the web as well as a fluid for digestive purposes. I failed, however, to find any difference in the structure of the cells that would justify this conclusion. The *œsophagus* is narrow, but soon passes into a large *crop* with corrugated walls, somewhat inflated. The *crop* is preceded by a small, almost globular tract, which I take to be the *proventriculus*. Into the base of this open four cæca, which are evidently the same as the proventricular cæca of the tipulid larva. Dufour in his *Ceroptatus* larva only figures two of these long cæca. The *stomach* is large, and its walls are much folded. Into its base, or distal extremity, open the *hepatic cæca*. I was unable to make much of these in the *Mycetophila* larvæ I examined. There are certainly four cæca, but whether they united into a single pair before entering the stomach, as shown in the figure of *Ceroptatus*, or entered as four separate tubes, as is usually the

case, I was unable to settle. The stomach passes into a *small intestine*, which somewhat suddenly becomes inflated, the latter part being the *large intestine*. The intestine is coiled several times, one of the chief features of the whole alimentary tract being its great elongation and also the same of its glands. The body cavity being densely packed with *adipose tissue*.

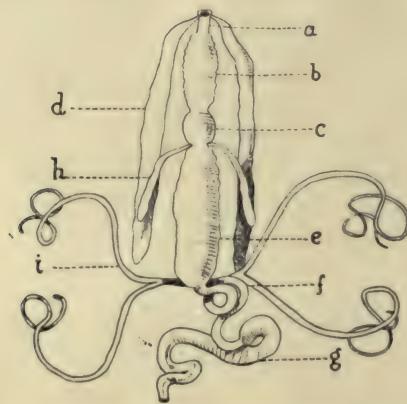


FIG. 16.—Alimentary Canal of Mycetid larva (*Mycetophila*).—a, oesophagus; b, crop; c, proventriculus; d, salivary glands; e, stomach; f, small intestine; g, large intestine; h, cæcal appendages (4?); i, hepatic cæca.

The *Nervous System* is composed of eight ganglia in *Mycetophila*, six in the body and two cerebral ganglia in the cerebral mass; viz., a supra- and infra-cesophageal united by a thin tract on each side.

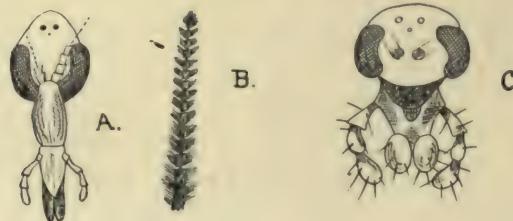


FIG. 17.—a, head of an *Asindulum*; b, antenna of *Asindulum* (hairs too long); c, head of a *Sciara*.

Characters of the Family (Imago).

Body elongated and compressed, often bare; head small; eyes round or oval, ocelli present two or three in number, unequal in size; palpi 4-jointed, cylindrical, the first joint very small.

Antennæ 10-16-jointed, porrect and simple; pronotum small; scutum of meso-thorax undivided; wings and halteres present except in *Epidapus*; the discal areolet wanting, veins few; abdomen, seven segments, rarely eight; legs formed for leaping; coxae large; tips of tibiae armed with large spurs; bristly hairs are developed on the legs, which are not, however, macrochætae.*

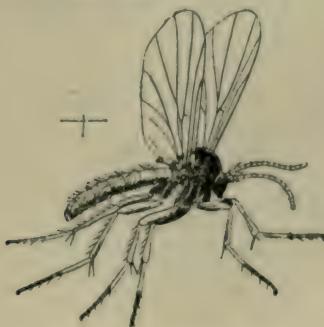


FIG. 18.—*Boletina dubia*.

Classification of Mycetophilidæ.

The family is now divided into eight sub-families, which are given below in tabular form :

A. Middle transverse vein elongated.	
a. Brachial vein wanting.	1. <i>Diadocidinæ</i> .
b. Brachial vein present.	
I. Antennæ not very long.	
a. Brachial vein long.	2. <i>Mycetobinæ</i> .
aa. Brachial vein short.	3. <i>Ceroplatinæ</i> .
II. Antennæ very long.	
b. Antennæ setiform.	4. <i>Bolitophilinæ</i> .
bb. Antennæ filiform.	5. <i>Macrocerinæ</i> .
B. Middle transverse vein not elongated.	
a. Brachial vein present, legs long.	6. <i>Sciophilinæ</i> .
b. Brachial vein wanting.	7. <i>Mycetophilinæ</i> .

* The Nematocera are characterized by the total absence of macrochætae. The stouter hairs on the thorax and scutellum of *Culex* and on the legs of the *Mycetophilidæ*, Osten-Sacken tells us, "can hardly be considered as such" (An Essay of Comp. Chætotaxy, Tr. Ent. Soc., Lond., 1884, Pt. 4). Continuing, he tells us "The Culicidæ, Chironomidæ and Tipulidæ are distinguished by the development and sexual differentiation of the antennæ, which are in this case very probably the organs of orientation. The same conclusion may be arrived at with regard to the Cecidomyidæ and *Mycetophilidæ*." The difference, however, between the bristly hairs on the legs of "Fungus Gnats" and the typical macrochætae of the *Muscidæ* seems to be very slight. On the legs of certain *Mycetophilidæ* and *Cecidomyiadæ* I have found curious club-shaped hairs; what their function is I do not know. Mr. Dale thinks they are probably to assist them in leaping.

- γ (i). Joints of antennæ cylindrical, petiolate or non-petiolate.
- (ii). Joints of antennæ in ♂ oval, petioles long; in ♀ sessile and cylindrical.

8. *Sciarinæ.*

The following are the characters of the more important genera found in Britain:

Sub-family *Sciarinæ*.*

- γ (i) 1. Wing longer than body; surface minutely hairy; joints of antennæ hairy.
- γ (i) 2. Wing small, shorter than abdomen; surface minutely hairy.
- γ (i) 3. Wings and halteres absent.
- γ (ii) 4. Wing much the same as *Sciara*, but the fork longer; basal branch wavy, and upper branch vaulted.

1. *Sciara*.

2. *Bradysia*.

3. *Epidapus*.

4. *Zygoneura*.

Sub-family *Mycetophilinæ*.†

A. Three ocelli on the front.

- I. Abdomen with seven segments.
 - a. Proboscis not elongated.
 - b. Costal extending beyond tip of cubitus.
 - c. Basal part of cubital vein and middle transverse vein equally long.
 - d. Auxiliary vein extending to costal.
 - cc. Basal part of cubital vein longer than the middle transverse vein.
 - d. Base of fourth hind areolet under base of cubital vein.
 - dd. Base of fourth hind areolet nearer base of wing than is the base of second hind areolet.
 - bb. Costal vein not extending beyond the tip of the cubitus.
 - aa. Proboscis elongated.

Anaclinia.

Leptomorphus.

Boletina.

Glaphyroptera.

Gnoriste.

* Beitrag zu einer Monog. der Sciarinen. Winnertz. Wien., 1867.

† The classifications of the following families is also according to Winnertz. Verh. Zool. Bot. Geo., 1863.)

II. Abdomen with six segments.

- a. Hind vein forked.
- b. Fork short.
- bb. Fork long.
- aa. Hind vein not forked.
- b. Middle discoidal forked.
- bb. Middle discoidal not forked.

B. Three ocelli: one on the inner border of each eye; third in the middle of the fore front.

- a. Costal vein extending much beyond the tip of the cubital vein.
- c. Two ocelli: one on the inner border of each eye. The third either in a pit and scarcely noticeable or absent.
- a. Base of fourth hind areolet nearly in a transverse line with that of the second hind areolet.
- b. Base of fourth hind areolet much more distant from base of wing than is the base of second hind areolet.
- c. Base of fourth hind areolet much nearer to the base of wing than is the base of the second hind areolet.
- b. Petiole of second hind areolet long.
- bb. Petiole of second hind areolet short.
- aaa. No fourth hind areolet.
- b. Fore cubital areolet moderately broad.
- bb. Fore cubital areolet very narrow.
- c. Hind vein not forked.
- a. Base of fourth hind areolet in a transverse line with that of the second.
- aa. Base of fourth hind areolet more distant from base of wing than is base of the second hind areolet.
- b. Costal extending a little beyond the cubital.
- c. Costal not extending beyond tip of cubital.
- a. Base of fourth hind areolet a little nearer base of wing than is the base of second hind areolet.

*Cælosia.**Leia.**Acnemia.**Azana.**Mycetophila.**Dynatosoma.**Cordyla.**Exechia.**Mycothera.**Zygomyia.**Sceptonia.**Dososia.**Anatella.**Phronia.*

- b.* Petiole of second hind areolet very short.
- bb.* Petiole of second hind areolet long.
- aa.* Base of fourth hind areolet much nearer to base of wing than is the base of second hind areolet.
- b.* Costal ends a little before tip of wing.

Rymosia.
Allodia.

Brachycampta.

Sub-family *Sciophilinae.*

- A.* Costal vein extending to tip of wing.
- B.* Costal not extending to tip of wing.
 - a.* Base of fourth hind areolet much nearer base of wing than is base of second hind areolet.
 - b.* Base of fourth hind areolet a little nearer to base of wing than is base of second hind areolet.
 - a.* Second hind areolet with very long petiole.
 - aa.* Second hind areolet with moderately long petiole.
 - c.* Base of fourth hind areolet in a transverse line with the base of the second, or very near the base of the wing.
 - d.* Base of the fourth hind areolet much more distant from the base of the wing than is the base of the second hind areolet.

Sciophila.

Empheria.

Polylipta.

Empalia.

Tetragoneura.

Lasiosoma.

Sub-family *Ceratoplinæ.*

- A.* Mouth elongated, like a beak.
- B.* Mouth not elongated like a beak.
 - a.* Antennæ dilated; palpi not bent together.
 - b.* Antennæ not dilated; palpi bent together.

Asindulum.

Ceratoplatus.

Platyura.

Sub-family *Mycetobinæ.*

- A.* Brachial vein and cubital forming a sessile fork.

Mycetobia.

B. Brachial vein and cubital forming a petiolate fork.

- a. Base of this fork is nearer to the base of wing than is base of second hind areolet.
- b. Base of this fork is more distant from base of wing than is base of second hind areolet.

Ditomyia.

Plesiastina.

The other three British sub-families only contain a single genus. The above synopsis is compiled from Winnertz, whose knowledge of the Mycetophilidæ is unequalled, although, as we shall see, very much has recently been done in Russia, especially by Dziedzicki.

Before ending the general account and classification of the fungus gnats, one word for their preservation. If, as mentioned in a former page, they do a certain amount of damage to *mushrooms*, the amount done is small compared with the benefits derived from their existence. The larvæ of these gnats act as "scavengers"; not only do they do away with rotting fungi, but they cause these often injurious productions to putrefy and to become scarce by their destruction. I have seen large fungi on chestnut trees that were gradually increasing in number, until one of nature's balancers came to the fore. The fungi, the first year of the attack of these Mycetid larvæ, decayed sooner than usual, and after that year they gradually decreased, until now scarcely any are to be found. This work was done, then, by these larvæ, which were abundant in most of the fungi, and from which I bred several species of Mycetids; had the production of the fungi continued at their rate of increase the trees must certainly have suffered. We now pass on to the more detailed part of the subject, and commence with the sub-family *Sciariæ*.

GENUS.—*Sciara*, Mg. =
$$\begin{cases} Chironomus, F. \\ Hista, F. \\ Molobrus, Macq. Lat. \\ Tipula, Lin. \end{cases}$$

The members of this genus are small, and generally dark in colour, elongated and attenuated posteriorly. The antennæ are porrect, 16-jointed, and have a few short hairs on each joint, the two basal joints devoid of hair. Five longitudinal nerves to the wings, the third forked and branching from the second about one-third from the base; wings longer than abdomen. Palpi curved downwards, 3 or 4-jointed. Proboscis large in proportion to the head; the labium is a

bilobed structure. Ocelli present, three in number, one much smaller than the other two. Eyes large, emarginate. No transverse sutures on the thorax. Halteres long. Abdomen elongated, seven segments. Legs slender, and slightly elongated; tibiæ armed with two spurs.

Their habitat is in grass, flowers, fruit and fungi.* The larvæ, which are cylindrical and shining white, live under the bark of decaying trees, also in fungi and *Boleti*, and, according to Walker, in putrescent galls.

Zetterstedt† says "sub-cortice arborum hybernant," but this does not always appear to be the case, as they sometimes hibernate in hay and straw. The pupæ have two divergent caudal setæ, and remain under the bark of trees and in the fungi; a cocoon may or may not be spun. In some respects the larvæ resemble *Mycetophila* larvæ, but they have no bristles or spines on the locomotive processes on the venter, as in the *Mycetophilæ*. One of the most remarkable characters of the larvæ of this family is their gregarious and migratory character. From the latter the name of "Army Worm," or in Germany "Heerwurm," has arisen. At certain times of the year large companies of this *Heerwurm* migrate in a long procession, sometimes as much as 14 feet in length, and 2 or 3 inches wide, and may be $\frac{1}{2}$ inch thick. This dense layer of larvæ must contain some millions of individuals, sticking close together and crawling over and over one another. The processions of the "Army Worm" are seen in Germany, Sweden, Russia and America. What this migration is for, still seems doubtful; the larvæ usually being full fed, it would not be for change of feeding ground. But Beling,‡ in a recent paper, comes to the conclusion that this is the object of the march. This latter view seems most natural were not the larvæ full fed. It was usually believed that the larvæ forming these masses were those of *S. Thomæ*, but Beling tells us they are those of *S. militaris*; in one case only did the larvæ belong to a different species.

The "Army Worm" has also been made known in America by Cope,§ who has published his observations on the appearance of this worm in Pennsylvania; and from this author's paper the following notes are taken: The rate of advance about four inches in five minutes, the hinder ones working their way over the top of the rest, the whole mass thus taking up in the rear and laying down in the

* A singular habit in this genus is that of two ♂'s frequently copulating with the same ♀. Mr. Dale has more than once seen them flying in that position.

† *Insecta Lapponica*, p. 825.

‡ *Der Heerwurm* (*Zeit. f. die ges. Naturw.* v. 46, 1883, pp. 253-271).

§ *Proc. Ac. Nat. Sc. Philad.*, 1867, p. 222.

front. They are said to resemble a thin gray snake when migrating in this manner ; and he records the attack on these bodies by ants and coleopterous larvae when on the march. Berthold* says "the Heerwurm can be regarded as a collection of larvae, for the purpose of mutual transformation : that is, it is accomplished through mutual protection at a period favourable to development. This connection is given up before the formation of nymphs arrives."

Another feature of interest in *Sciara* larvæ is the possible production of galls by *S. tilicola*, as described by Winnertz, but Professor Mik and Osten-Sacken seem inclined to doubt this. Of course it is possible that the *Sciara* larvæ live as *inquilines* in the galls produced by some Cecid.

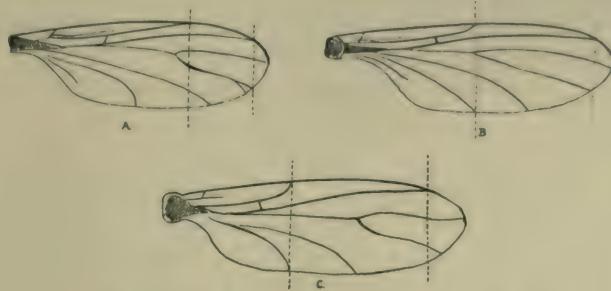


FIG. 19.—The three types of venation in *Sciara*.

This genus has three well-defined types of wings, and is divided into three distinct groups by the following characters : (a) The second longitudinal joins the costal *beyond* the fork of the fourth longitudinal. (b) The second longitudinal vein joins costal *at* the level of fork. (c) The second longitudinal vein joins costal *before* the fork.

$$S. Thomæ, L. = \begin{cases} S. lateralis, Mg. \\ Tipula Thomæ, Lin. and Schrk. \\ Histeia Thomæ, F. \\ Molobrus Thomæ, Lat. \end{cases}$$

This species has a black shining thorax. Abdomen fuscous ; the ♀ has a yellowish band on each side. Antennæ black, short, smaller in ♀ than in ♂. Wings almost black, and shiny ; the second longitudinal vein extending much beyond the fork of the fourth, and more than half length of wing. Legs short and moderately stout, femora testaceous, coxae and tarsi dark brown. The abdomen and thorax have dark brown hairs.

This species, which is common, appears in the summer and

* Nachrichten Univ. Göttingen, 1854, p. 1.

autumn in woods and thickets. The larvæ are known to congregate in large numbers, and may possibly abroad form the so-called "Heerwurm" in some instances. This is the largest of the genus. It does not hibernate.

S. carbonaria, Mg.

This insect is almost black all over. The thorax is shining; antennæ a little longer than head and thorax; wings hairy, shining brown in ♂, darker in the ♀. Costa faint; second longitudinal vein dark brown. The abdomen of the ♂ is longer and slenderer than in the ♀, and the wings with shorter hairs. Legs testaceous; tarsi dusky brown.

Found in the spring and summer; rare in England, but not so on the Continent. Winnertz* says: "Ich habe sie Laufig auf Weiden blüten augetroffen, und auch in copulo gefangen."

S. morio, F. =
$$\begin{cases} Histea forcipata, F. \\ S. florilega, Mg. \\ S. lugubris, Wtz. (?) \end{cases}$$

This species is black, shining. Wings blackish, darkest along the costa; halteres piceous at base, knobs black. Second longitudinal vein ending much beyond the fork of the fourth, and much beyond half the length of the wing. Abdomen in ♂ slightly hairy, in the ♀ with a yellow line on the sides when alive, this disappears at death. Legs piceous; tips of femora in ♂ testaceous, dusky in the ♀.

Dale† records this from West Cornwall, and it is mentioned as being common in Walker. Verrall places it amongst the reputed species for some reason. Loew‡ obtained the larvæ from the stalks of *Aretium*.§

S. quinquelineata, Macq.

This is a species mentioned by Curtis,|| and was reared from rotten potatoes.

The *imago* is black, with shiny thorax, with five whitish lines; wings nearly transparent; abdomen blackish-brown. Legs dark black; ends of coxae and femora testaceous, tarsi dark. Antennæ yellowish.

S. præcox, Mg. = *S. fascipes*, Mg. ♀.

Black; thorax black and somewhat shiny; palpi black; antennæ

* Mon. der. Sciarinen, 1867, Wien., p. 14.

† Diptera of West Cornwall, 1890-91.

‡ Dip. Beiträge, fasc. 4th, p. 18, 1850.

§ This is probably the same species as *carbonaria*.

|| Curtis, "Farm Insects," p. 460, 1860.

short and stout in ♂ and in ♀. Wings brownish; veins dark; second longitudinal vein ending just before fork of third longitudinal vein; fourth longitudinal vein distinct. Abdomen fuscous; halteres piceous; legs short and stout; dark.

Found in May on and about the Bilberry; generally abundant.

Heeger* gives the following account of the habits of this species: "The females lay their eggs in decaying fungi or vegetable mould. The eggs are in short strings, from six to ten in a row. If the weather is favourable and the temperature moderate the larvæ are excluded in eight or ten days. They shed their skin three times, at irregular intervals, depending on the conditions of heat and moisture. Before undergoing the pupa-state they form near the surface of the soil a little barrel-shaped case, out of which the pupa extricates itself in part before the exclusion of the perfect insect. The shedding of the skin and transformation generally take place in the morning; copulation more frequently in the evening."

S. pulicaria, Mg.

This has been reared from putrescent galls and, according to Curtis,† from rotten potatoes. It is found in the autumn about gardens and on windows.

The *imago* is black; thorax shining black, with abdomen dark blackish brown. Wings glassy; costal nerves dark; the remainder pale; fourth longitudinal vein pale before its fork; second longitudinal vein ending much before the fork of the fourth. Halteres brownish, with black knobs. Legs testaceous; tarsi blackish.

S. flavipes, Panzer.

In this gnat the thorax is testaceous, with a small pale band on the humeral region. Abdomen dark above, yellowish on ventral surface. Palpi black and testaceous. Antennæ black; testaceous at the base; longer in ♂ than ♀. Coxæ yellowish-brown; tarsi brown; wings nearly limpid; veins light brown; fourth longitudinal vein pale before the fork; second longitudinal vein extending to half length of body; not up to the fork of fourth.

The fly appears in summer amongst bushes and underwood, and is fairly common.

S. hyalipennis, Mg.

This is another plentiful species found in gardens and hedges about the end of May and June.

* Beiträge, etc., Sitzb. d. Wien. Ac. xi., p. 27, T. ii.

† Curtis, "Farm Insects," p. 460, 1860.

The perfect insect has a brown thorax with four black stripes. The abdomen is dark brown, almost black. Antennæ brown. Wing nearly limpid (*sub hyalinis*), with the veins dark. The second longitudinal vein extends to the fork of the fourth longitudinal vein. The latter is indistinct before the fork. Halteres brownish. Legs testaceous or yellowish ; tarsi brown, or even black.

Meigen obtained this species from flower-pots.*

S. pallipes, F. = { *Tipula pallipes*, F.
 Chironomus pallipes, F.

Black ; thorax slightly shiny ; ventral surface yellowish. Antennæ slender, $\frac{1}{4}$ -length of body. Wings limpid ; veins dark-brown. Second longitudinal vein extending to fork of fourth longitudinal vein before joining the costa, more than half the length of wing. Fourth longitudinal vein pale before the fork. Legs yellowish ; tarsi dark.

Walker says this species is common, but Verrall evidently doubts its authenticity, it being in italics in his list. The life-history appears to be unknown.

S. tilicola, Lw.

This fungus gnat is supposed by Loew to form a gall on the leaves of young linden trees. Winnertz first discovered this curious habit, and noticed that the galls were present on the leaves in shady and sheltered situations : "The lemon-yellow larvæ, capable of *leaping*, like cheese maggots, lives in numbers in the stem, generally near the origin of the last or two last leaves. Each of them has a hollow of its own, and produces a swelling of the size of a pea, which it abandons before its transformations."† Osten-Sacken and Professor Mik do not believe this account. They consider the galls are formed by some Cecid, and that the *Tilicola* larvæ are only "inquiline" in the galls.

It is most probable that the galls are the same as those described by Walker as produced by *Cecidomyia tiliæ* on the young shoots growing from lime-trees. He says : "They (the galls) are round or oblong ; more than twenty cells, each inhabited by one larva. The latter is about one line of length, and of a *bright yellow colour*, and has the faculty of *leaping*, like the larva of *Piophila*."

The *imago* of *Tilicola* is dusky, with somewhat shiny thorax. Antennæ slender, yellowish. Wings nearly limpid, with costal nerves brown ; the remainder pale. Legs dusky yellow ; tarsi dark, with somewhat yellowish bases.

* Eur. Zweif, i., p. 233.

† Character of larvæ of Mycetophilidae, Osten-Sacken, p. 17.

S. Ruficauda, Mg.

This is slightly smaller than *Thomæ*, and can easily be distinguished from it by its red abdomen. Dale has taken it from rotting hay and straw in the autumn.

There are a large number of this genus found in England. Winnertz, in his "Monograph of the Sciarinæ," describes 175 species, and those who wish for detailed descriptions, and who intend working at this group, should consult it. As it seems a somewhat rare work in England I append his method of classifying this genus of the Mycetids :

- I. The second long. vein (unterrandader) joins the costa at or beyond the fork of the fourth long. vein. (Fig. 19, A, B.)
- A. Wings black or brown.
 - I. Antennæ black or brown.
 - A. Transverse veinlet situated *before* the middle of the second long. vein.
 - a. The apex of the cubitus (second long. vein) lies nearer to the apex of the wing, than does the apex of the lower prong of the fork.
 - β. The apex of the cubitus (second long. vein) and that of the lower prong are equidistant from the apex of the wing.
 - γ. The apex of the lower prong of fork is nearer the apex of wing than the apex of the cubitus.
 - B. The transverse veinlet is situated *in* the middle of the second long. vein.
 - a. β. and γ. as above.
 - C. The transverse veinlet is situated beyond the middle of the second long. vein.
 - a. Only.
 - B. Wings yellow.
 - I. Antennæ black or brown.
 - A. Transverse veinlet situated *before* the middle of the second long. vein.
 - α. and β.
 - B. Transverse veinlet situated *in* the middle of the second long. vein.
 - α. Only.
 2. Antennæ yellow.
 - A. Transverse veinlet situated before the middle of the second long. vein.
 - β. Only.
 - II. The second long. vein joins the costa before the fork of the fourth long. vein (Fig. 19, c.)
 - A. Wings black or brown.
 - I. Antennæ black or brown.
 - A. α, β, γ, as above.
 - B. α, β, as above.
 - C. α, β, γ, as above.
 2. Antennæ yellow.
 - A. γ, as above.
 - B. α, β, γ, as above.
 - B. Wings yellow.
 - I. Antennæ black or brown.
 - A. α as above.
 - B. α as above.
 - C. α, β, as above.
 2. Antennæ yellow.
 - A. α as above.
 - B. α, β, γ, as above.
 - C. α, β, γ, as above.

The British species of this genus tabulate as below:

A. Second long. vein extends beyond fork of fourth long. vein.

- Wings dark brown or black
 - Sides of abdomen yellowish
 - Sides of abdomen black
 - Sides of abdomen black
 - Abdomen red
- Wings gray
 - Legs testaceous, thorax with three cinereous stripes
 - Legs testaceous, thorax black, shiny
- Wings nearly limpid, abdomen elongated

AA. Second long. vein extends to the fork of the fourth long. vein.

- Piceous, cinereous stripes on thorax
- Black, veins dark
- Black, veins pale

AAA. Second long. vein not extending to fork of fourth long. vein.

- Halteres brown or black
 - Wings brown
 - Wings gray
 - Wings limpid
- Fourth and fifth veins dark
 - Large
 - Small
- Fourth and fifth veins light
 - Second long. vein ending at about half length of wing
 - Second long. vein shorter, not half length of wing
- Halteres testaceous, with black on knobs
 - Piceous, thorax with gray stripes
 - Black, thorax black
- Halteres testaceous or white
 - Body black or brown
 - Fourth and fifth long. veins dark
 - Fourth and fifth long. veins pale
 - Body slender
 - Halteres testaceous
 - Halteres whitish
 - Body very slender
 - Body tawny
 - Body testaceous
 - Slender : tarsi black
 - Very slender : tarsi brown

NOTE.—*Quinque linea* is not given by Verrall as a true British species; five white lines on the thorax distinguish it at once.

GENUS.—*Bradysia*, Wtz.

This is a genus founded by Winnertz, and contains only three species. It is distinguished by the shape, etc., of the wings. The characters of the wings are as follows: Shorter than the abdomen, narrow, minutely hairy, with "*bald mehr bald weniger keit fôrmiger Basis*" (Fig. 20). There is only one British species mentioned in the list, viz. :

This species is testaceous, with black head and antennæ. Wings very short and narrow. Hind borders of the abdominal segments blackish. Tarsi brown.



FIG. 20.—Wing of *Bradysia*.

Walker describes this from a specimen in the British Museum. It seems to agree closely with *Angustipennis*, described in detail (♀) by Winnertz, and this author says concerning this point: "Die Identität derselben mit *Sciara brevipennis*, Walk, ist nicht unwahrscheinlich." Dale has taken this under stones in company with ants.

GENUS.—*Epidapus*, Hal = *Chionea*, Curtis.

Thorax much compressed behind, so as to seem conical from above. Wings and halteres wholly obsolete. Abdomen incrassate in the middle; tip attenuated, decurved, furnished with the ordinary two linear obtuse pubescent and free valves of the ovipositor.



FIG. 21.—*Epidapus venaticus*.

E. venaticus, Hal.

Thorax black; abdomen piceous, hairy; palpi yellow; antennæ shorter than body; legs testaceous; lamellæ of ovipositor round.

The larvæ live in the rotten wood of *Carpinus betulus*.

GENUS.—*Zygoneura*, Mg.

Osten-Sacken places the genus in the Cecidomyidæ on account of the following characters: (1) the coxæ being far less elongated, and the spurs of the tibiae far shorter than in other genera of the *Mycetophilidæ*; (2) antennæ moniliform with verticillate hairs, seen in Cecids, but never in "Fungus Gnats." The same author continues

to state that "the total habitus of the *Zygoneuræ* being more like that of the former (*Cecidomyidæ*) than of the latter (*Mycetophilidæ*), and the tibial spurs being so very short, that in some species they can only be discovered by the closest scrutiny, I think I may be justified if I add them to the *Cecidomyidæ*, though in many respects they agree with the genus *Sciara*, which has its place amongst the *Mycetophilidæ*.* But in other characters it approaches very closely to *Sciara*, and so it is placed amongst the *Mycetophilidæ*. No doubt it is a transitional form between the two families, and I see no reason why it should be placed one side of the line more than another; but as it is so placed by Brauer, and as this work follows his classification, it is placed in the present family.



FIG. 22.—Wing of *Zygoneura*.

The characters of the genus are as follows: Ocelli present, three in number. Labium bilobed. Palpi 3-jointed, curved downwards. Antennæ 16-jointed: in ♂ vorticillate and pedicelled joints; in ♀ pubescent, joints sessile. Thorax elliptical. Branches of fourth longitudinal vein very arcuate at the base. Halteres long. Tibial spurs small or absent. One species is recorded in England, and is somewhat scarce.

Z. sciarina, Mg.

Black, shining thorax. First part of the fourth longitudinal vein pale; rest of veins black. Halteres testaceous. Palpi yellow. Antennæ in ♂ as long as body; in ♀ shorter than body. Legs yellow; tarsi dark. Found in summer and autumn in underwoods.

At the next genus we enter the second section, viz., the *Mycetophilinæ*.

GENUS.—*Cordyla*, Mg. = *Pachypalpus*, Macq., Zett.

The characters of this genus are as follows: Body narrow. Ocelli two, small, contiguous to the eyes. Palpi thick at base, short. Antennæ incrassated, short and thick. Number of joints vary in sexes and species, and also in form. Wings rather short. Abdomen somewhat compressed and slender. Legs short; tibiae armed with longish spurs. The veins of the wings resemble *Mycetophila*. The larvæ also are said to resemble those of *Mycetophila*, one *C. crassipalpa*, Macq., has been figured and described (larva and pupa) by Dufour.†

* Dip. N. America, pt. i., p. 7.

† Ann. des Sc. Nat., 2e series V., xii. and xiii. (pp. 5-60 and 148-163).

They live upon fungi. There are possibly four or five British species.

C. brevicornis, Staeg. = *C. valida*, Wlk.

This seems to be a rare species, and is described in Walker under the name of *Valida*. Recorded from Glanvilles-Wootton and the New Forest.

The *imago* is yellowish, stout, and compact. Lanceolate antennæ shorter than thorax; joints short. Wings grayish and stout. Veins tawny. Legs are stout, with longish spurs; brown tarsi; hind tibiæ armed by very minute spines. The second longitudinal vein ends at before two-thirds of length of wing. Sub-anal (fifth longitudinal vein) being forked and nearer base of wing than the fork of the sub-apical (fourth longitudinal vein). Length 2 lin.

C. flaviceps, Staeg.

Head yellowish. Thorax tawny or yellowish in front, also sides, and under surface. Antennæ and palpi yellow. Wings having the fork of the fifth longitudinal vein much further than the fork of the fourth longitudinal vein from the base of wing. Legs tawny, short, and thick, long spurs; tarsi dark; posterior tibiæ with minute spines. Length 1 lin.

GENUS.—*Mycetophila*, Mg.

This is an important genus, of which eleven species are recorded from Great Britain and twelve more are reputed; whilst Walker describes about fifty.

The characters of the genus are as follows: Body generally small, elongated, and hairy. The head is sessile and transversely broadened; round in outline. Eyes are far apart and oval. Ocelli two in number. Proboscis short. The palpi 4-jointed (Meigen* only figures three joints; the first joint being very small, was evidently overlooked). The three joints are nearly equal. Antennæ 16-jointed; not more than half length of body; filiform to cylindrical; setaceous; very thick in some species. The thorax very convex and generally oval; metathorax small and sloping down to level of the abdomen, which is of seven segments, and compressed, especially in the ♀; in the ♂ it is more cylindrical. The wings are often spotted and of moderate length and breadth; the second longitudinal is straight, and ends just before three-quarters of length; the third longitudinal vein emitting the sub-apical

* "Sys. Besch. d. b. Eur. Zwei. Insecten," t. 2, tab. 9, fig. 17 (1820).

(fourth) a little before middle of wing. It forms an angle with the transverse veinlet, and then passes straight to the margin, a little in front of the tip of the wing. The sub-apical (fourth longitudinal vein) is forked. The remaining vein—the sub-anal (fifth longitudinal vein)—is forked in some; in others simple. Anal (sixth longitudinal vein) does not reach margin, and varies in length. There is also a small veinlet (humeral) near the base of wing. *Base of fourth hind areolet nearly in a transverse line with that of the second hind areolet.* Legs slender; coxae long; the four hind tibiae spinose, with two long spurs; only one spur on fore tibiae and spines scanty. Tarsi longer in fore legs than hind. The curious formation of the legs, which are adapted to their hopping and skipping movements, are very characteristic, and resemble the legs of *Pulex*. The larvæ of this genus have been mentioned in the general account, and so we can now pass on to some of the species found in this genus. The genus, as taken by Walker, included about fifty-one species; but the old genus *Mycetophila* is usually divided into several distinct genera or, more correctly, sub-genera. The differences between *Mycetophila* and *Rymosia* and *Exechia* are, for instance, very slight, and although they are separated off as distinct genera, in my opinion the characters are not sufficiently marked to justify them being raised to that position.

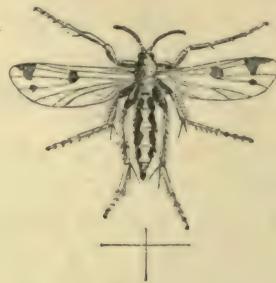


FIG. 23.—*Mycetophila ringulum*,* Mg.

$$M. punctata, \text{ Mg.} = \begin{cases} M. striata, \text{ Wlk.} \\ M. semicincta, \text{ Mg.} \\ M. cunctans, \text{ Wied.} \\ M. rufa, \text{ Macq.} \end{cases}$$

This is a large and common species ($2\frac{1}{2}$ lin. long, 4-5 lin. alar). The general colour tawny. There are three large reddish spots on

* *M. cingulum*, Mg. This is a testaceous species, with tawny abdomen. Wings also tawny in front, marked as in Fig. 23. Not very common. Length $1\frac{1}{2}$ to 2 lin.

the thorax ; the middle one placed before the two lateral ones. Pectus testaceous. There are also ferruginous bands on the abdomen. The wings are marked with a tawny hue. The veinlets of the præ-brachial areolet forming a right angle, the fore one about half the length of the hind one, and nearly as long as the fourth longitudinal before its fork. The fork of fifth nearer base of wing than fork of the fourth longitudinal vein. Tarsi are brown ; legs tawny ; tibiæ covered with long stout spurs ; fore tibiæ longer than fore metatarsi.

M. stolida, Wlk.

This species is described* as being blackish-brown. The antennæ are tawny at the base and no longer than the thorax. Palpi tawny. Thorax clothed with pale down ; tawny in front, on each side, and beneath. Wings gray ; transverse veinlets of the præ-brachial areolet slightly clouded with brown ; veinlets of the præ-brachial areolet forming an obtuse angle, the hind one longer than the fore one and twice the length of the fourth longitudinal vein before its fork ; fork of fifth longitudinal vein further than fork of fourth from the base of wing. Halteres testaceous. Legs tawny, short and stout. Tarsi blackish ; hind femora with black tips ; fore tibiæ longer than fore metatarsi.

M. signata, Mg. = *M. distigma*.

The life-history of this species seems to be roughly known. Stannius† reared it from *Boletus edulis*, found especially in pine-woods. The larvæ, according to Osten-Sacken, spin their cocoons without leaving the fungi. The cocoon is truncated at one end, and this truncature covered with a delicate web, which the fly breaks through in escaping. The larvæ, as in all of this genus, are yellowish-white and stout, the horny head being brown. The *imago* is yellow to rusty yellow ; the thorax with three distinct and dark-brown longitudinal stripes, the middle one expanded in front ; sides of the thorax sometimes brown. Abdomen variable in colour ; yellow, the anterior segments marked with brown, and divided into two spots by a line down the middle ; the sixth segment and ♂ organs tawny. Head yellow and brownish in parts ; antennæ brown ; yellow at the base. Legs tawny yellow ; hind femora brown ; tarsi brownish. Wings yellowish ; tawny veins ; a brownish spot on

* "Ins. Brit.", vol. iii., p. 15.

† Bemerkungen über einige Arten Zweiflgl. Gattungen. Macrocera etc. Isis, 1830.

the tip of the *præ-brachial* areolet and another near the *costa*. Length, $1\frac{1}{2}$ to 2 lin.

M. lunata, Mg.

The metamorphosis of the species has been well followed by Heeger, but in his paper are many curious and erroneous statements, as seen in the following quotations: "The stigmata are nine, on nine consecutive segments of the body, except the two first;" and another more important point, viz., "The locomotive swellings and their bristles are described on the back of the larva," etc., etc.

The eggs are $\frac{1}{5}$ lin. long, cylindrical and white. The *larvæ* are stout white maggots, with a dark-brown corneous head. The eggs may be laid by the ♀ singly or in patches (twenty to thirty) on the same fungus. The larvae hatch after eight or ten days, and commence to burrow into the under side of the pileus. They shed their skin three times, and transform near the outer margin. Haliday says: "The larvae spins for its transformation a long pouch of silk (white), with a flat circular lid." The pupal state lasts nine to twelve days, the fly generally coming out in the morning. The perfect insects and pupæ hibernate, and appear in the spring. Bremi obtained it from *Agaricus citrinus*, and Haliday also records the larvae as living gregariously in the hollow stalks of Agarics.

M. bimaculata, F. = $\begin{cases} M. arcuata, Zett. \\ M. pictula, Mg. \end{cases}$

This is a somewhat rare species in England. It is brownish-black and covered with pale yellowish hairs. Head blackish-brown. Palpi yellowish. Antennæ blackish-brown; yellowish at the base. Thorax with a yellowish stripe on each side, which is largest and broadest in front. Abdomen blackish-brown; ♂ genitalia brown; ♀ with blackish-brown lamellæ. Wings with a brown spot, which passes from the *costa* to the *præ-brachial* areolet, and at three-quarters of length with a gray band, which is brown in front. Tips of wings gray. The veinlets of the *præ-brachial* areolet form an obtuse angle. The fifth longitudinal vein forked beyond the fork of the fourth longitudinal vein. Halteres brownish-yellow. Legs testaceous; tarsi brown. Length, $1\frac{1}{2}$ to 2 lin. This is a large species, with alar expansion of 4-5 lin.

M. lineola, Mg. = $\begin{cases} M. ruficollis, \text{ Macq.} \\ M. lurida, \text{ Mg.} \\ M. monostigma. \\ M. centralis. \end{cases}$

This is more common and smaller than the above species. The general appearance is dark brown, but the head is tawny. The palpi yellowish-red, and the antennæ tawny at the base. There is a tawny stripe on each side of the thorax, as in *bimaculata*. The wings are gray, and there is a brown spot on the tip of the præ-brachial areolet and of the fork of the fourth longitudinal vein. The veinlets of the præ-brachial areolets form nearly a right angle. The abdomen is brown, with tawny bands on the hind borders of the segments, and having a white tomentum underneath. The ♂ genitalia yellowish-brown; ovipositor (♀) yellowish. Legs testaceous; tarsi darker than tibiæ; the latter armed with many stout spines. Length, $1\frac{3}{4}$ to $2\frac{1}{2}$ lin.

M. lutescens, Zett. = *M. Senata*, Steph.

Somewhat like *cingulum*, but as large, or larger, than *punctata*. Occurs from Glanvilles-Wootton to N. Scotland.

GENUS.—*Rymosia*, Wtz.

Three ocelli, one near each eye and the third in front; very small. The costal does not extend beyond tip of the cubital. The base of fourth hind areolet a little nearer base of wing than is base of the second hind areolet, with the petiole of the latter very short. Legs long and slender. Metamorphosis unknown.

R. fenestralis, Mg. = $\begin{cases} M. rufa, \text{ Macq.} \\ M. domestica, \text{ Mg.} \end{cases}$

Winnertz says the larvæ live in *Agaricus melleus*. The perfect insect is black to reddish-brown. Vertex with white tomentum. Head dull yellow to brown; proboscis and palpi yellow; antennæ brown; base yellow. Antennæ twice the length of thorax in the ♂; about the same length as thorax in the ♀. Pectus and sides of the thorax yellowish-red. Wings having the præ-brachial areolet closed by two veinlets, which form an acute angle, the hind one longer than the fourth longitudinal vein before its fork. Anal vein very short. Abdomen club-shaped; blackish-brown; testaceous beneath; with testaceous bands for half the length from the base; the base testaceous in the ♀; brown in the ♂. The ovipositor is composed of three angular valves; the lamellæ thin and oval. The colour varies in the male. The legs testaceous; spurs

short; tarsi brown; tibiæ dark; very short spurs in hind ones. Length, $2\frac{1}{2}$ to 3 lin.

R. fasciata, Mg. = $\begin{cases} R. maculosa, \text{ Zett.} \\ R. discoidea, \text{ Zett.} \\ M. zonata, \text{ Steph.} \end{cases}$

This is a common species, reddish-yellow in appearance, with testaceous ventral surface. The palpi and antennæ are testaceous; the latter dark at the base. The two veinlets, which form the præ-brachial areolet, make a right angle; the posterior one very much larger than the fore one; about three times the length of the fourth longitudinal vein before its fork; the hind branch curved. The anal vein extends far beyond fork of fourth longitudinal vein. The abdomen is brownish-black, with four testaceous bands on the fore segments; the extremity of the abdomen is testaceous. The legs are long and slender, dark reddish-brown; tarsi almost black; spurs long; very small on hind tibiæ; the fore tibiæ much shorter than fore metatarsi. Length, $1\frac{1}{2}$ to 2 lin.

There are four other British species of this genus; viz., *truncata*, Wtz.; *maculosa*, Mg.; *selecta*, Wlk.; and *sericea*, Mg.

GENUS.—*Dynatosoma*, Wtz. = *Mycetophila*, Mg.

This genus much resembles *Mycetophila*. There are two ocelli only. *The base of the fourth hind areolet is much more distant from the base of the wing than is the base of the second hind areolet.*

D. fuscicornis, Mg. = $\begin{cases} M. fuscicornis, \text{ Mg.} \\ M. præusta, \text{ Staeg.} \end{cases}$

This is the only species of this genus found in Britain. It was formerly included in the *Mycetophilæ*, and was described as one by Walker; but it is now raised to a distinct genus by Winnertz.

The *imago* is blackish-brown; thorax tawny in front, with three dark-brown spots; palpi yellowish. Antennæ yellowish at the base; abdomen with a white tomentum beneath; legs yellowish; tarsi brownish; tips of posterior femora dark-brown; fore-tibiæ long. Wings grayish-brown, with two distinct brown spots, one on the tip of the præ-brachial areolet and of the fork of the fourth longitudinal vein, the other near the costa; fifth longitudinal vein forked; sixth does not extend to the fork of the fifth. Length $1\frac{1}{2}$ to 2 lin. Found in the autumn and winter.

GENUS.—*Exechia* = *Mycetophila*, Mg.

The ocelli two, small. Sides of the thorax with bristles. Abdomen

club-shaped, flattened at the sides. Wings somewhat short. Base of fourth hind areolet much nearer the base of wing than is base of the second hind areolet. Petiole of second hind areolet long. Fourth longitudinal vein short. Larvæ live in fungi.

E. fungorum, Dg. = *M. fusca*, Latr., Mg.

This is a fairly common species. The larvæ living in the pileus of *Boletus* and other fungi.

Imago dark-brown. Head brown, palpi and antennæ yellowish-red; the latter dark-brown at the tip, very slender, and about the length of thorax. Thorax brown, tawny on each side; with grayish and small black hairs on parts. Abdomen blackish-brown, with tawny extremity. Pincers small and tawny. Wings with a brownish tinge; the veinlets of the præ-brachial areolet forming a slightly obtuse angle, the hind one much longer than the fore one, and about four times as long as the sub-apical vein before its fork. The anal (sixth longitudinal vein) does not extend as far as the fork of the fifth longitudinal vein. Legs pale yellow, slender; tarsi brown; hind tibiæ with minute spines and very long spurs. Length 2 to $2\frac{1}{2}$ lin.

E. lateralis, Mg. = $\begin{cases} M. guttiventris, Mg. \\ M. seriata, Zett. \end{cases}$

This is another fairly common British species. It is dark brown, with testaceous ventral surface. Head brown; antennæ testaceous at base, dark brown at distal extremity, about as long as thorax. The thorax, which is brown, and covered in parts by minute gray and black hairs, is testaceous or tawny at the sides. The abdomen has five triangular testaceous spots on each side, the second and the third each forming a band above. The wings have the veinlets of the præ-brachial areolet forming a slightly acute angle, the hind one nearly eight times the length of the fore one; the anal does not extend to the fork of sub-anal. The legs are long and slender and testaceous; spurs long; tarsi brown. Length $1\frac{1}{2}$ to 2 lin.

These are the only two common species in this genus, but the following also occur in England: *leptura*, Mg., *dorsalis*, Staeg., *indecisa*, Wlk., *tarsata*, Staeg., *leioides*, Wlk., *ferruginea*, Wlk., *flava*, Wlk., and *fuscula*, Wlk.

GENUS.—*Allodia*.

Slender, tawny or brownish-black genus. Antennæ sometimes cone-shaped. Resembles *Rymosia*, but the petiole of the second hind areolet is long.

$$A. crassicornis, Stan. = \begin{cases} M. punctipes, Staeg. \\ M. Spinicoxa, Zett. \end{cases}$$

This is a dark species. The head is yellowish-red; the palpi are yellowish. Antennæ testaceous at the base. Antennæ are stout, and in the ♂ longer than the thorax; in the ♀ they are shorter and lanceolate. Head and thorax covered with a gray tomentum. The thorax has a reddish-yellow stripe on each side; these two stripes are broadest in front. The abdomen is yellowish-red (yellow according to Schiner) on the ventral surface, and also on the hinder parts of each segment. The ovipositor and male genitalia are testaceous, and sometimes brown. The wings have a yellowish tinge; the hind veinlet of the præ-brachial areolet about twice the length of the fore one. The anal does not extend to fork of sub-anal. The legs are yellowish-brown, and fairly long; tibiæ and tarsi brown; fore tibia much shorter than the fore metatarsi. The spurs and spines on the posterior tibiæ long. Length 2 to $2\frac{1}{2}$ lin. Fairly common at times.

$$A. ornaticollis, Mg. = \begin{cases} M. grata, Mg. \\ M. lugens, Mg. \\ M. analis. \end{cases}$$

This is also a common species. It is testaceous, some almost dark brown. The head is dark brown, and the vertex has a white tomentum. The thorax is also blackish-brown, the sides having a white tomentum. The proboscis and palpi reddish-yellow; antennæ dark brown, yellowish at the base. The abdomen seems to be liable to a large amount of variation, and there seem to be three distinct types of variation:

- (α) Blackish-brown, with small yellowish patches (= *ornaticollis*);
- (β) Entirely blackish-brown, with bright incisions (helleren Einschnitten) = *lugens*;
- (γ) Or blackish-brown, with triangular yellowish patches from the second to the fourth segment, and with testaceous anal segment (= *grata*).

Walker, again, describes his *ornaticollis* as having a large triangular blackish-brown spot on each dorsal segment. The legs are moderately long and testaceous; tarsi brown; posterior tibiæ having longish spines; the anterior tibiæ are much shorter than the anterior metatarsi. The wings are transparent and grayish, the costa and its neighbourhood being tinged with yellowish-red. Length $1\frac{1}{2}$ to $2\frac{1}{2}$ lin.

GENUS.—*Mycothera*.

Moderately small, dark brown and yellowish-brown genus; wings with brown markings. Head round. Fourth joint of palpi long. Antennæ 16-jointed. Eyes roundish; ocelli small, the middle one standing in a little cavity. Abdomen 6 or 7-jointed; hypopygium small. The wings large, and the petiole of the second hind areolet is short, not long as in *Exechia*.

M. semifusca, Mg.

This is a dark brown species, and, according to Walker, it has a gray tomentum. The head is brown. The thorax is also dark brown, with a testaceous spot on each side, has bright yellowish hairs on it. Abdomen dark brown; the ♂ genitalia small; the ovipositor tawny; lamellæ brown. Palpi testaceous. Antennæ brown, about length of the thorax, testaceous at the base. Wings marked with pale brown across the middle and at the tips. Legs testaceous, tibiæ and tarsi brown; posterior femora also brown at their distal extremity; spines on posterior tibiæ very small. The anterior tibiæ longer than anterior metatarsi. Length $1\frac{1}{4}$ to $1\frac{1}{2}$ lin. This does not appear to be a common species, nor does the other one that is found in England, viz., *M. dimidiata*, Staeg. = *ocellus*, Wlk.

GENUS.—*Brachycampia*, Wtz.

The costal vein ending a little before the tip of the wing; base of fourth hind areolet much nearer base of wing than is base of second hind areolet. Metamorphosis unknown.

B. bicolor, Macq.

This gnat varies from rusty yellow to brown, with a grayish tinge. Head brown; thorax brown and testaceous pectus; abdomen testaceous, with brown markings. Anal segment small; palpi testaceous; antennæ brown or black, testaceous at base, stout, shorter than thorax. Wings yellowish, with a brownish tinge. Legs yellowish; tarsi brown; the posterior tibiæ have only a few spines, and very long spurs; anterior tibiæ nearly same length as the anterior metatarsi. This is an uncommon species, and the only one of the genus found in England. Length $1\frac{1}{2}$ to 2 lin.

GENUS.—*Docosia*, Wtz.

The base of the fourth hind areolet is in a line with that of the second hind areolet. Head oval, proboscis short; palpi bent, 4-jointed—first joint small, the fourth flat and very long. Antennæ 16-jointed;

eyes round, ocelli three. Abdomen cylindrical, 7 segments, anal segment and ♂ genitalia small; ovipositor short, two small lamellæ. The larvae live in fungi and rotten wood. The gnats are found in woods and thickets.

D. sciarina, Mg. = *M. gilvipes*, Hal.

This is a slightly ferruginous gnat, covered by whitish hairs. Palpi yellow; antennæ blackish-brown and thick; the second joint has a long hair above. Eyes dark and oval; ocelli three in number, almost in a straight line. Thorax ferruginous. Wings minutely pubescent; first, second, and third veins reddish-brown: "Das steile Basalstück der dritten Längsader liegt verder Basis der Gabel der vierten Längsader, bei *S. valda* liegtes jenseits dieser Basis."

The legs are rather stout and thick, tibiæ darker than femora; a thick row of small spines on posterior tibiæ, the spines are stouter in the hind tibiæ; tarsi brown. Length $1\frac{1}{4}$ to 2 lin.

Winnertz found the larvae in *Boletus scaber* and *edulis*, and in *Hydnus repandum*; also in rotten wood.

The species *D. valida* is also found in England. It has a chocolate thorax, and is much darker than *sciarina*. It appears in May.

GENUS.—*Phronia*, Wtz.

This genus has been admirably worked out by Dziedzicki,* and a most detailed and true classification has been brought forward by him. After giving the characters of this genus and the two British species, I will then give a short account of the method of classification he has adopted.

Characters of genus: Moderately small, rusty yellow to brown in colour. Head roundish, and segment large. Anterior tarsi always longer than the tibia. Wings rather short, costa extends now and then beyond the apex of the third longitudinal. The first longitudinal vein generally incomplete, sometimes it ends at the costa; fourth longitudinal vein with short petiole; the fifth with a long petiole and generally a very small fork; sixth and seventh longitudinal veins rudimentary.

P. austriaca, Wtz.

Head yellowish-brown. Palpi yellow. Antennæ brown; first segment yellow. Thorax yellow, with three dark brown stripes, which are confluent at their origin. Halteres yellow, or whitish-yellow. Abdomen of six segments, dark brown above, yellowish-

* Ent. Hor. Rosslandæ, t. xxiii., 1889.

brown beneath. Legs yellow; tarsi of the anterior legs 2-3 times longer than the tibiae of the corresponding legs; the tibiae are in the same proportion to the corresponding metatarsi. The ovipositor: the *pars basalia supera* with a deep angular hollow on the posterior side, and with a slight arched depression on the sides; the w hole external surface of the lamella almost bare, and not clothed with any little hairs. The *pars basalia infera*: the posterior border notched in form of a parenthesis, and covered by a single row of small hairs. The *anterior lamella* cylindrical, with the surface covered by delicate hairs; the superior edge has also a single row of long hairs. The *posterior lamella* small, pyriform. Length $1\frac{1}{2}$ to $1\frac{1}{2}$ lin.

They appear in May, June, July and August, according to Dziedzicki.

P. nitidiventris, V. d. Wulp.

The larvæ of this species live in rotten wood.

The ♂ organs blackish-brown. The posterior border of the *lamina basalis* is divided into three blunt lobes by two moderately deep cuneiform depressions; the middle lobe is the largest and more convex than the lateral; the external surface is covered by delicate hairs. The *forceps inferior* is almost rectangular in form, the external border larger than the internal; the posterior border furnished by a row of strong and also long hairs; the whole external surface covered by delicate hairs. The *forceps superior*, sickle-shaped (*faucilliforme*), furnished on the posterior borders and on the internal with small hairs; in the middle of this last piece is a triangular lamella furnished on its superior border with a row of strong hairs; on the external parts of the forceps are found membranous lamellæ with rows of rods (*baguettes*).

Ovipositor brown. The *pars basalis supera*: the posterior border is notched with three semicircular depressions, the middle one much deeper than the lateral ones; the external surface is bare, and there is a fine and long hair at the posterior angle. The *pars basalis infera* is a truncated triangle in form, with the posterior angles rounded; the external surface and posterior border are covered by delicate hairs. The *ant.*, or *superior lamella*, is heart-shaped, depressed in a deep arch on the posterior surface; the external surface covered by minute hairs. The *post.*, or *inferior lamella*, is in the form of a button, and is furnished with some short and strong hairs. Length $1\frac{1}{2}$ to $1\frac{1}{2}$ lin.

The *imago* is found in May, June, July and August.

The descriptions of these two British examples of the genus *Phronia* are taken from Dziedzicki's monograph of the genus. He

bases his classification and specific characters on the sexual organs, viz., the *Hypopygium* or ♂ copulatory organs, and the *ovipositor* (Legeröhre or ♀). The great importance of these two parts cannot be over-estimated, as they form the most decisive specific characters. The colour and nervation of the wings, etc., cannot be relied on, especially in the Mycetids, where the variation seems to be very great, and although, as pointed out by Professor Mik, the use of the hypopygium and ovipositor as specific characters necessitates the destruction of the species, it is far better to do so and thus find out what the true species are, than to be adding numbers of species, which are mere variations in colour and nervation. Is it not far better to have the hypopygium or ovipositor of an insect identified than the perfect fly which we cannot definitely identify? The great importance of these organs cannot be valued enough as specific distinctions. I will now give an account of the *Hypopygium* and *Ovipositor* (of the genus *Phronia*).

The *Hypopygium* (Fig. 24). This is composed of the following

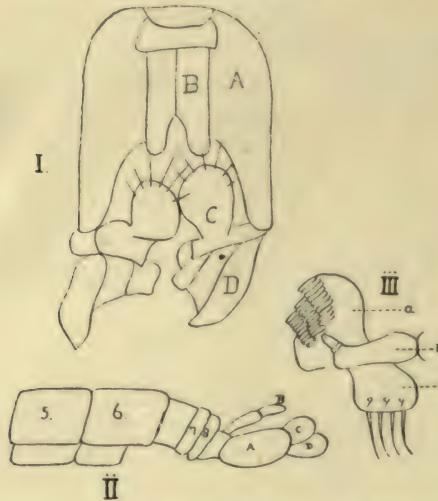


FIG. 24.—♂ genitalia = hypopygium of *Phronia*. I. and II. A = laminae basalis; B = lam. superae; C = forceps superior, D forceps inferior; III. = forceps superior.

parts: (i.) *lamina basalis*; (ii.) *laminae superae*; (iii.) *forceps inferior*; (iv.) *forceps superior*; (v.) and the *appendix interna*, or *adminiculum*.

(i.) The *lamina basalis*, which forms the greater part of the hypopygium, is attached to the sixth abdominal segment by the modified two last segments (seventh and eighth). The posterior surface of the lamina is indented in various

ways in the different species; the forceps join the posterior surface.

- (ii.) The *laminæ superæ* are two in number and lanceolate. They cover the summit of the lamina basalis. They are movable, and easily elevated upwards or downwards. There are two plates at the base of the laminæ.
- (iii.) The *forceps inferior* simple, often notched and curved in various ways, and very hairy. This part forms a great specific character.
- (iv.) The *forceps superior* formed of three distinct parts: (1) The "trone" (*b*), which varies a great deal in form. (2) The "lamella" (*c*), which is generally a triangular plate, the superior border being furnished with spines, which are long and strong. (3) The "membranous lamella" (*a*). This is wrinkled in various ways and furnished with recumbent, horizontal rows of rods (*baguettes*), smooth and compact. There is also another lamella present, joined to this, oblong in form and variable in shape, directed towards the interior; a few hairs present.
- (v.) The *appendix interna*, or *adminiculum*. This is found to be present in the middle of the basal lamella and beneath the two *laminæ superæ*. They are small structures, and not easily found in Mycetids.

The *Ovipositor* (Legeröhre). This is also composed of five parts: The *pars basalis supera*; the *pars basalis infera*; the *lamellæ anteriores*; the *lamellæ posteriores*, and the *vaginula*. (Vide Fig. 25.)

- (i.) *Pars basalis supera* (*A*). This corresponds to the eighth dorsal abdominal segment. It is a simple plate, which is indented on the posterior border in various ways.
- (ii.) The *pars basalis infera* (*E*). This corresponds to the eighth ventral abdominal segment. It is also a simple piece, with various indentations in the different species.
- (iii.) The *lamellæ anteriores* (*B*) are movable plates of various shapes, the superior border being edged with a few long hairs.
- (iv.) The *lamellæ posteriores* (*C*) are joined to the lam. ant., and are surmounted on their summit or extremity by short, strong hairs.
- (v.) The *vaginula* (*D*). This underlies the ant. and post. lamellæ.

Of course these parts vary, not only in each family, but in each genus and species; their study is at present in a very unsatisfactory state

By this means alone will a satisfactory separation of the species of *Mycetophilidae* be accomplished. The paper from which this has

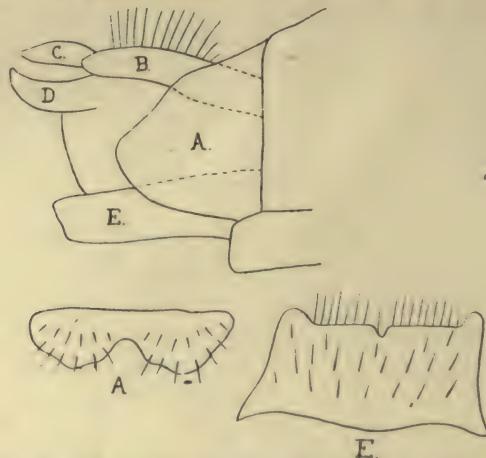


FIG. 25.—♀ genitalia = ovipositor (Legeröhre) of *Phronia*.

been mainly compiled shows amply the great specific importance of the structure of the sexual organs.

GENUS.—*Sceptonia*, Wtz.

This is a small, dark-coloured genus. The middle tibia has one row of black spines on its inner surface. The costa passes beyond the apex of the third longitudinal. The anal is incomplete (sixth), and the seventh longitudinal vein is very long.

The larvae live in fungi and rotten wood. The gnats are found in shady woods.

S. nigra, Mg.

This is a black species, about $1\frac{1}{2}$ to $1\frac{1}{4}$ lin. in length. The head is black; the palpi testaceous; the antennæ black, testaceous at the base. The anal segment and hypopygium testaceous; the ovipositor brown, with yellow lamellæ. Legs testaceous; tarsi brown; black tips to femora; fore tibiae longer than fore metatarsi. Wings yellowish or with a brownish-yellow tinge (Walker describes them as gray).

This fly appears in woods and thickets fairly plentifully from April to October.

GENUS.—*Zygomyia*, Wtz.

Head roundish; proboscis short; palpi, eyes, and ocelli as in *Exechia*. Forehead drawn forward in a triangular shape; head with

anterior border somewhat projecting. Legs tolerably long, anterior ones shortened; femora strong and thick; posterior femora very thick; tibiae strong, club-shaped, spurred; anterior ones devoid of spines; posterior with two rows of strong lateral spines; posterior tarsi with fine spines. Abdomen 6 to 7 jointed; ♂ genitalia small. Wings minutely hairy.

Z. notata, Stan.

This is a blackish-brown insect; head dark brown; palpi yellow; antennæ brown, with yellow base; glistening yellowish-gray hairs on the abdomen. Anal segment small, yellowish. Ovipositor and lamellæ brown. Legs testaceous, the apex of the hind femora brown. Wings with a yellowish-gray tinge; root and costa yellow, with a discal brown spot. Length, $\frac{3}{4}$ to $1\frac{1}{2}$ lin.

This gnat is found in woods and copses, the larvæ living in rotten wood. There are the following also found in Britain:

Valida, Wtz. (Verh. d. Zool. Bot., Ges. xiii., 902-1. 1863.)

Pictipennis, Staeg. (Staeger, Kröj., Tidskr. iii., 266-41. 1840).

Vara, Staeg., *ibid.*, 42; and *paludosa*, Staeg.

GENUS.—*Azana*, Wlk.

Small dark insects. Head small and oval; lower than thorax. Palpi small and short. Antennæ stout and 16-jointed, not longer than thorax. The thorax is convex. The abdomen is compressed and of moderate length, the anal segment blunt and the hypopygium small. Wings fairly broad. The costa passes beyond the apex of the third longitudinal vein; fourth and fifth longitudinal veins simple; sixth rudimentary. Transverse veinlet small, long, and nearly horizontal. Metamorphosis unknown.

A. anomala, Staeg. = *A. scatopoides*, Wlk.

This is the only species in this genus, and was first described by Walker. The gnat is black, with grayish wings; yellowish hairs. The head, palpi, and antennæ mostly black; the base of the latter occasionally testaceous. Legs piceous, stout, and long; hind tibiae with minute spines and fairly long spurs. Tarsi brown. Halteres tawny, with black knobs. Length, about $1\frac{1}{2}$ lin. This genus is closely allied to *Mycetophila*. Appears in May and June.

GENUS.—*Acnemia*, Wtz.

Head round; flat in front; proboscis short; antennæ 16-jointed, arched. Eyes oval. Ocelli three, the middle one small; some-

times in a straight line. Abdomen cylindrical, with large anal segment and small hypopygium, short ovipositor, and two strong lamellæ. Legs long, stout, and strong. Wings longish and rounded. The costa passes beyond the apex of the third longitudinal. The upper and lower branch of the first longitudinal form together one transverse veinlet. The fourth longitudinal vein is forked, and the fork has a short petiole; sixth longitudinal vein very short. The larvæ live in fungi and rotten wood.

A. defecta, Wlk.

The perfect insect is black. Testaceous palpi. Antennæ 16-jointed, sub-moniliform, a little longer than thorax. Abdomen testaceous at the tip. Wings nearly limpid, first longitudinal vein joining costa before one-third length of wing, united by a little transverse veinlet with the second longitudinal vein, at some distance from its tip; the second is united to the third by a veinlet, which is a little beyond the base of the fourth vein; third joining the costal near the tip of the latter; fourth and fifth slight, the former forked near its base. Legs testaceous; trochanters partly black; spurs long; tarsi blackish, minutely setose beneath. Length, 1 lin.

This species seems only to be described by Walker, from whom this account is compiled.

A. nitidicollis, Mg.

Black with shiny hairs, thorax shiny; hypopygium and lamellæ of ovipositor yellowish; antennæ 16-jointed, brown; palpi yellowish. Legs testaceous; tarsi brown; base of legs brown. Wings brownish; base and veins brown. Length, 1½ lin.

A. amœna, Wtz.

This is a yellowish species also found in England. Length, 2 lin.

GENUS.—*Glaphyroptera*, Wtz.

Most of the species in this genus seem to have been placed in the old genus *Leia*, and many of them are described under this head by Walker and Meigen. Head roundish, flat above; proboscis short; palpi 4-jointed; fourth joint very long—as long as the three preceding ones together. Antennæ 16-jointed. Eyes oval; ocelli three, in a semicircle; central one small; lateral ones large near the eyes. Thorax very convex. Abdomen with seven segments, slender, short anal segment and small genitalia (♂). Legs fairly thick; tibiæ with long spines. Wings generally with spots or bands. Fourth and fifth veins forked.

$$G. fascipennis, Mg. = \begin{cases} L. fasciola, Mg. \\ L. flavigornis, Mg. \\ L. consobrina, Curtis. \\ L. crucigera, Zett. \end{cases}$$

This gnat is yellowish, with testaceous ventral surface. Palpi yellow; antennæ brown, yellowish at the base. Legs yellowish-brown, with brown tarsi. Wings with a yellowish tinge, testaceous at the base, and having a gray sub-apical band. The first longitudinal vein short, united to second longitudinal vein by a transverse veinlet; fork of the fifth longitudinal vein much nearer than the fork of the fourth to the base of wing. This is an abundant species, and is especially common on oak and lime trees.

There are about a dozen of this genus found in England—the one described is the commonest. The larvæ live in fungi and rotten vegetable matter.

The larva of *G. fasciola*, Mg. (*fascipennis*) is described by Van Roser* as follows: "The transparent, smooth and slimy larva lives in delicate webs on the surface of tree fungi." They strongly resemble *Sciophila* larvæ in habits and structure.

G. Winthemii, Lehm. = *Leia Winthemii* Wlk. (Ins. Brit.).

This species is testaceous. The thorax has three brown stripes, the middle one being divided. Wings with three gray bands, which seem to vary, sometimes being almost absent. Abdomen has a dark band on each segment at the ventral edge. An autumnal species. Recorded by Dale at Glanville Wootton.

G. subfasciata, Mg. = *Leia Marklini*, Zett., is the only other certain British species; there are many others recorded as British, but their records want verification.

G. pulchella, Curt., is a bright ochreous species, with a dark spot on the thorax; the first and second abdominal segments have a black spot; third, fourth and fifth have a black ring; sixth and seventh black. Recorded by Curtis and Haliday, and taken on umbelliferæ.

$$\text{GENUS } Anaclinia, \text{ Wtz.} = \begin{cases} \text{Mycetophila, Mg.} \\ \text{Leia, Macq.} \\ \text{Boletina, Zett.} \end{cases}$$

This genus resembles *Leptomorphus*, but the ocelli are nearly of the same size, and are arranged in a straight line. Abdomen flattened laterally. Wings microscopically hairy; third vein, simple; fourth and fifth forked; sixth vein not extending to the edge of wing. *The costa extends over the apex of third vein.*

* Verz. Württemb. Dipt., 1834.

A. nemoralis, Mg. = *Boletina elongata*, Curtis.

Blackish-brown. The body long, slender, shining; head brown; hairs yellowish; thorax with a tawny spot on each side in front. Palpi yellowish; antennæ blackish-brown, yellowish at the base. Wings with brownish tinge, yellowish costa and brown veins; third longitudinal vein undulating; fourth longitudinal vein not forked, but accompanied by a secondary vein, ending behind the tip of the wing; fork of fifth and tip of *præbrachial* areolet at an equal distance from the base of the wing; sixth vein fairly long. Legs testaceous, long and slender; brown at their base and also the tarsi; hind tibiæ brownish, no spines. Length 3 lin. Not an uncommon gnat. The life history unknown.

GENUS *Boletina*, Staeg. =
$$\left\{ \begin{array}{l} \text{Mycetophila, Mg.} \\ \text{Leia, Mg.} \\ \text{Leptomorphus, Wlk.} \end{array} \right.$$

This genus of gnats much resembles the *Mycetophilæ*, but they are of a more slender build than the latter, and the sub-costal, or first longitudinal vein, is much longer. The following may be taken as the chief characters of the genus: Body 7-segmented and slender, cylindrical in ♂, subfusiform in ♀; thorax large, convex, short; head small, and ventrally placed; eyes oval, ocelli three, central one below lateral ones and small; the palpi are curved outwards. Proboscis scarcely elongated. Antennæ slender, 16-jointed compressed, about twice the length of thorax in the ♂, and about same length as thorax in the ♀; very few hairs. Wings broadish; costal vein not long, scarcely reaching tip of wing; first longitudinal vein long, nearly half length of wing; second longitudinal straight, not ending quite at the tip; third longitudinal vein joins tip of costal; fourth and fifth forked; sixth distinct, but not reaching the border of the wing; seventh small. Legs slender, of moderate length; a few bristles on the tibiae; spurs longish. Hypopygium and ovipositor small. These gnats frequent woods and damp places, and in their habits they much resemble *Mycetophilæ*. The larvæ live in fungi and in rotten wood. Beling* describes one from rotten and "decaying leaves in a forest of deciduous trees" in Denmark. Closely allied to this genus is *Gnoriste*, which is not, however, found in England. The *Boletinæ* seem to be northern insects, many being found in Norway, Sweden, Greenland, Lapland, etc.; but they are equally abundant in warmer climates.

* Wieg. Archiv., etc., 1875, p. 56.

B. dubia, Staeg.

This is a black gnat. Head and thorax covered by a gray tomentum ; antennæ slender, 16-jointed and a little longer than the thorax. The abdomen is long and dark. Wings have the fork of the fifth longitudinal vein nearer to the base of wing than the fork of the fourth longitudinal vein ; sixth extends nearly to the fork of the fifth. Legs testaceous, long and slender ; tibiæ dark, posterior tibiæ with long spurs and short spines : tarsi black. Length 3 to $3\frac{1}{2}$ lin.

B. sciarina, Staeg. = $\left\{ \begin{array}{l} \text{Mycetophila sciarina, Mg.} \\ \text{M. obscurella, Zett.} \end{array} \right.$

This is a blackish-brown species, very widely distributed. Zetterstedt describes it from Norway, etc., under the name *obscurella*. It is, according to Walker, slightly covered by a gray tomentum. Palpi and antennæ are blackish-brown ; the antennæ are twice the length of the thorax. The body is clothed with yellowish hairs. The anal segment is longer than the one before it. The legs are testaceous, and the spurs short ; tarsi blackish-brown, and the hind tibiæ with very few short spines. The wings have a grayish tinge ; second and third longitudinal veins very distinct, brown ; the fourth and fifth pale ; the sixth fairly long, extending beyond the fork of the fifth. Length $1\frac{1}{2}$ to 2 lin.

The other British species are *trivittata*,* Mg. (System. Beschr. i., 258, 10) ; *borealis*, Zett. (Dipt. Scand., xi. 4, 160, 8) ; *plana*, Wlk. (Ins. Brit., vol. iii., p. 34) ; *analis*, Mg. (System. Beschr., i., 257, 9).

GENUS *Leptomorphus*, Curtis.

This genus was formed by Curtis, one species only being known. The body is slender ; head small ; palpi 4-jointed, long and slender,



FIG. 26.—Head of *Leptomorphus Walkeri*.

fourth joint longest. Eyes oval ; ocelli two. Antennæ 16-jointed, filiform, about half length of body. Thorax very short. Abdomen compressed, thickened at the tip ; the hypopygium large. Legs long and slender, very small spines to tibiæ and very long spurs. Wings narrow, hairy ; costal ends a little in front of tip of wing ; first longitudinal vein long, connected with the second by a transverse veinlet

* Taken at Linton, Ivybridge, Loch Maree and Tongue, in June. (Verrall.)

near its junction with the costa ; there is another transverse veinlet near this, between second and third veins ; the third longitudinal is united with the tip of the costa, and is not forked ; the fork of the fourth much beyond the fork of the fifth, which is nearly opposite the transverse veinlets ; the sixth extends beyond the fork of the fifth. This is figured by Curtis. The metamorphosis is unknown.

L. Walkeri, Curtis.

Testaceous ; head tawny ; thorax with three blackish-brown stripes, united behind. Palpi and proboscis testaceous ; antennæ brown, yellow at the base. Ocelli brown. Abdomen brown towards the tip, posterior borders of the segments darkish, the hypopygium golden yellow ; yellowish hairs. Wings grayish at the tip ; a brown spot at the tip of the prebrachial areolet ; veins dark brown. Legs testaceous ; tarsi brown and spurs dark brown. Length 5 lin. Mr. Dale found this species in September at Glanville Wootton. The flight much resembles that of a Plume Moth (*Plerophorus*).

SECTION 3.—*Sciophilinæ*.

Body elongated and slender. Head small. Eyes round or oblong. Ocelli three, the middle one small. Proboscis short. Palpi 4-jointed, curved downwards ; fourth joint long. Antennæ 16-jointed. Wings broad ; *two cubital areolets* ; first longitudinal vein reaching costal in some (*Sciophila*, etc.), much shorter in others (*Tetragoneura*), *united to second longitudinal vein near its base by a transverse veinlet* ; fourth vein forked ; fifth usually forked ; sixth vein long, but not reaching the border of wing. Abdomen with 7 segments. Legs long and slender.

The larvæ of this section may at once be known from those of *Mycetophila* by their elongated form and different mode of life. They do not live as the *Mycetophilinæ* larvæ inside the fungi, but they prefer the surface of the pileus, generally the under side ; this they cover with a dense net in which they live.* Others live in decaying wood, especially when covered with *Byssus*. The larvæ form slimy tracts, like slugs, and on these they move backwards and forwards with great rapidity. The pupæ are enclosed in dense cocoons of silk. The maggots are usually whitish or yellowish, and often live in the same fungi as *Mycetophilæ* larvæ, and hence great mistakes have been made in the descriptions of the larvæ. The luminosity of these

* I have also found *Sciophila* larvæ living *inside* some tree fungi, which they had covered with their webs. They crawled out of their tunnels as soon as the weather became warmer (March), and crawled about amongst the webs.

larvæ has been mentioned before (pp. 97, 98). The maggot of a *Scizophila* is figured on page 96. (Fig. 15 A.)

GENUS.—*Empalia*, Wtz.

The costal vein does not extend to the tip of the wing; the base of the fourth hind areolet a little nearer to the base of the wing than is the base of the second hind areolet. The petiole of the latter moderately long.

E. vitripennis, Mg.

Blackish-brown. Head dark brown; proboscis and palpi yellowish; antennæ brown, tawny at base. Thorax dark brown, yellowish on each side. Abdomen dark brown, ferruginous at the tip; lamellæ of ♀ yellow, and the ovipositor and anal segments. Legs light yellow; tarsi dark brown; base of legs brown; femora with dark spots at the apex; the end of the posterior femora and tibia brown; anterior tibia with two, middle and posterior with three rows of dark spines; the anterior tibia much longer than the metatarsi. Wings sometimes brownish, pale at the base; fourth and fifth veins pale. Length $1\frac{3}{4}$ to $2\frac{1}{2}$ lin.

GENUS.—*Empheria*, Wtz.

The first longitudinal vein does not extend to the tip of the wing; the base of the fourth hind areolet is much nearer the base of the wing than is the base of the second hind areolet.

E. pictipennis, Hal.

Yellowish. Thorax yellowish-brown, sides pale. Abdomen has first and second segments unspotted; third and fourth blackish-brown with testaceous hind border, fifth and sixth almost black: hypopygium yellowish; lamellæ of ovipositor yellow. Head yellow, front and vertex brownish; proboscis yellow; palpi and antennæ brownish, the latter yellowish at the base (first and second joints), scarcely as long as the head and thorax together. Wings with two brown bands; one in the middle of the wing, passing beyond the areolet, and "sinuated thence to the hind border; the other sub-apical, extending to the tip of the radial vein."

Legs pale yellow; tibia brownish; tarsi brown; anterior tibia sometimes longer than the metatarsi. Length $1\frac{3}{4}$ to 2 lin. Appears in October. This is a rare species; it was found in Kent, and described by Mr. Haliday.* Mr. Dale records this also from Glanville Wootton in the *Ent. Mo. Mag.*, 2nd series., vol. i., p. 109 (1890).

* *Ent. Mag.*, I. 156 (1833), and Winnertz, *Verh. d. Zool. Bot. Ges.*, xiii. pp. 742-745 (1863).

GENUS.—*Tetragoneura*, Wtz.* = $\left\{ \begin{array}{l} \text{Sciophila, Curtis et Zett.} \\ \text{Mycetophila, Mg.} \end{array} \right.$

Body slender and elongated. Head small and round, flat above. Eyes round. Proboscis short. Labium short and fleshy, rigid in front and hairy. Coxæ elongated, femora compressed, lateral spines on hind tibiæ. Wings longer than abdomen; costal does not extend to tip of the wing. First longitudinal vein very short, third ending



FIG. 27.—Head of *Tetragoneura Sylvatica*.

before tip of wing: base of the fourth hind areolet in a transverse line with the base of the second, or very near the base of the wing. Joints of the antennæ cylindrical. The larvæ live in fungi and rotten wood.

T. hirta, Wtz. = *S. dissimilis*, Zett.

Black, clothed with whitish hairs. Thorax with grayish tinge, beset with large light hairs. Abdomen in ♂ dark brown with light hairs and somewhat shiny, ventral segment yellow; in the ♀ the abdomen is yellow, the segments have a black dorsal stripe and black bands, except the sixth and seventh segments, which are entirely black. Hypopygium yellow; ovipositor and lamellæ brown. Head dark brown, vertex sometimes grayish; proboscis and palpi yellow. Antennæ dark brown, basal and second joints yellow. Wings hyaline, costa dark, areolet oblong; second and third longitudinal veins brown, the rest pale; the first longitudinal ending in the second before its middle; fork of fourth longitudinal opposite apex of areolet; fork of the fifth nearly at the base of the wing. Legs light yellow; coxæ and tips of posterior femora dark brown, the latter has a black streak at the base on the ventral side; tibiæ and tarsi brown; posterior tibia longer than metatarsus. Length 1½ lin. This is a rare species. Haliday records it from Ireland.

There are two other species of this genus recorded from Great Britain, viz., *sylvatica*, Curtis, Brit. Ent., xiv., 641, 16 (1837), and Winnertz, Verh. d. Zool. Bot. Ges., xiii. 766. 2 (= *distincta*) and *melanoceras*, Wlk., vide Walker, Ins. Brit., Dip., vol. iii., p. 46.†

* Ent. Zeit. V., Stett. vii. 18 (1846).

† *Sylvatica* = Black; proboscis, palpi and second joint of antennæ yellow

The round head and circular eyes, the ocelli being nearly equal and in a curved line, and the cylindrical joints of the antennæ, besides the veins, at once distinguish this genus.

GENUS.—*Lasiosoma*, Wtz. = *Sciophila*, Mg.

The larvae of this genus live in fungi and rotten wood. The gnats may be found in woods and thickets. The genus may be distinguished by the base of the fourth hind areolet being much further from the base of the wing than is the base of the second hind areolet. It is nearly allied to *Sciophila*, but the costal does not extend to the tip of the wing as it does in *Sciophila*. There are seven species of this genus found in Great Britain.

L. hirtum, Mg. = $\begin{cases} S. hirta, \text{ Hoffm.} \\ S. pilosula, \text{ Zett.} \end{cases}$

Blackish-brown. Head brown. Palpi testaceous; antennæ longer than thorax. Abdomen brown. Legs yellow; tarsi brown, yellow at the base; posterior femora dark at the base and tips; posterior tibiae also dark at the tips.

Wings with a brownish-gray tinge; first cubital areolet of moderate size, *oblong*. This is a fairly abundant species. Length $1\frac{1}{2}$ to 2 lin.

L. rufilaterum, Wlk. = *S. rufilatera*, Wlk.

This is a dark brown insect; palpi yellowish; antennæ blackish-brown, tawny at the base. Thorax with a tawny spot on each side in front. Abdomen tawny on each side, except towards the tip. Legs tawny; tarsi brown; posterior tibiae with minute spines and rather long spurs. Wings grayish. First cubital areolet very small, almost *square*. Length $1\frac{3}{4}$ lin. Scarce species.

The following are the other British species :

L. luteum, Macq. Dale has bred this species from larvae feeding in a web on a fungus on a pear tree. The imago is yellowish, with dark brown head.

L. ochraceum, Wlk., Ins. Brit. Dip., vol. iii., p. 41. *L. maura*, Wlk., *ibid.* p. 42. *L. fenestrella*, Curtis, British Ent., 641 (1837). *L. rufum*, Mg.

GENUS.—*Monoclonia*, Mik.

M. halterata, Staeg.

This is a rare species, resembling *S. (L.) rufum*, Mg., in appearance. The imago is testaceous; the head has front and vertex dark-

Thorax blackish-gray, beset with long whitish-yellow hairs. Areolet minute. Abdomen as in *hirta*. Sub-costal obsolete.

Melanoceras = Antennæ quite black. Sub-costal complete. Areolet elongated and dilated at the tip. Holywood, near Belfast (Haliday).

brown ; the thorax shiny and covered with pale hairs. The abdomen brownish. Palpi brownish ; antennæ dark brown, first and second joints yellowish. Legs short, yellowish ; posterior tibiæ have short, but distinct spines. Wings hyaline ; veins stout and brown ; areolet small ; first longitudinal vein connected with second before the areolet ; fork of fourth longitudinal vein with very short petiole. Length $2\frac{1}{2}$ lin. This species may be known from *L. rufum* by being shorter in legs and antennæ and by the stout veins.

GENUS *Sciophila*, Mg. = $\begin{cases} \text{Platyura, F.} \\ \text{Asindulum, Lat.} \end{cases}$

In this genus the costal vein extends to the tip of the wing. The body is slender and elongated. Head small. Proboscis short. Palpi four-jointed, fourth joint long and slender, first and second joints short. Antennæ 16-jointed, as long in ♀, longer in ♂, than head and thorax. Eyes oblong ; ocelli three in number. Thorax short, with black hairs. Abdomen slender, seven segments, cylindrical in ♂, fusiform in ♀. Legs long and slender ; femora hairy, tibiæ setose ; spurs moderately long. Wings moderately broad, minutely hairy ; first longitudinal vein slightly curved towards its tip, often united with costal, and connected with second longitudinal near its tip by a transverse veinlet ; third longitudinal arises from the second before the middle of the wing ; fourth longitudinal forked at beyond the middle of wing ; fifth forked, forks nearly straight ; seventh very near the base. Areolets twelve, including two cubitalis.

S. tenuis, Wlk.

This gnat is slender and tawny. Head tawny, vertex black. Palpi and proboscis yellowish ; antennæ dark brown, yellowish at the base. Thorax has three dark stripes, the middle one long, the lateral ones short. Abdomen tawny. Legs yellowish, long and slender ; posterior tibiæ with minute spines and very short spurs. Wings nearly limpid ; transverse veinlet springs from the first longitudinal vein opposite the middle of the first cubital areolet. Length $2\frac{1}{2}$ lin. Appears to be uncommon ; found in August.

S. fasciata, Zett.

Yellowish ; head with vertex black ; antennæ dark, yellowish at the base. Three black stripes on the thorax, lateral stripes short. Abdomen black, with a yellowish border on the posterior edge of each segment. Legs yellowish ; tarsi brown ; posterior tibiæ with

minute spines and long spurs. Wings with a faint brownish tinge; cubital areolet *not clouded*. Length 2 to 3 lin.



FIG. 28.—*Sciophila Fasciata*.

This is a common species, and resembles *S. marginata*, but the latter has the cubital areolet clouded. *Marginata*, Mg., is 2½ to 3 lin. long. As far as I can make out, *S. hilaris*, Wlk., is the same as *fasciata*, Zett.

Other British species are :

S. hyalinata,* Mg. Verh. d. Zool. Bot. Ges., xiii., 713, 6.

S. congrua, Wlk. This is a black species, with tawny palpi; a ferruginous spot on each side of the thorax in front; scutellum and pectus ferruginous.

S. trivittata, Zett. Gray, hoary beneath. Testaceous spot on each side of thorax in front. Abdomen testaceous beneath and along the hind borders of the segments on each side. Found in May.

S. cingulata, Mg. Meig., 1 c. I. 102, 5; Zw. i., 247, 5 (1818).

S. ornata, Mg. Winnertz, Verh. d. Zool. Bot. Ges., xiii., 725, 18.

S. fimbriata, Mg. *Ibid.*, xiii., 736, 29. Meigen, Zw., 247, 3.

S. ferruginea, Mg. Zw. i., 249, 9.

S. ruficollis, Zett. ? Zetterstedt, Dip. Scan., xi. 4121, 17.

S. punctata, Mg. Winnertz, Verh. d. Zool. Bot., Ges., xiii., 714, 7.

* *Hyalinata*, Mg. Testaceous; vertex black, abdomen brown, hind borders of segments testaceous.

Cingulata, Mg. Testaceous; vertex brown.

Fimbriata, Mg. Tawny; vertex piceous.

Ferruginea, Mg. Testaceous; vertex black; brown band on hind border of each abdominal segment.

Ruficollis, Zett. Testaceous; sutures and tip of abdomen black.

Punctata, Mg. Tawny; vertex black.

Trilineata, Zett. Testaceous; abdomen pale ferruginous.

Ineisurata, Zett. Testaceous; vertex brown. Abdomen brown; pale testaceous band on hind border of each segment.

Ornata, Mg. Testaceous; abdomen testaceous; second to fifth segments with black borders.

S. trilineata, Zett. *Ibid.*, xiii. 734, 27.

S. incisurata, Zett. = *S. annulata*, Mg. *Ins. Lapp.*, 859, 7 (1840). Zett. and Zw., i, 247, 4 (1818). Meigen.

SECTION 4.—*Ceroplatinae.*

Antennæ 17-jointed, not very long. Ocelli three, middle one small. Thorax elliptical. First longitudinal vein short; third, fourth and fifth veins forked; brachial vein short. Body long and narrow; eight segments.

A. Mouth elongated like a beak.

GENUS *Asindulum*, Ltr. =
$$\begin{cases} \textit{Tipula}, \text{F.} \\ \textit{Platyura}, \text{Zett.} \\ \textit{Macrorrhyncha}, \text{Wtz.} \end{cases}$$

The insects of this genus are slender, and their bodies are long. Head (Fig. 17A) oval and depressed in front; vertex convex; front broad. Eyes oblong; ocelli three, middle one small. The mouth is produced into a short rostrum: the proboscis is long and bifid, elongated lips. Palpi 4-jointed; first joint small, third and fourth fairly long and nearly equal. Antennæ: first and second joints cyathiform, remainder cylindrical, except seventeen, this is conical; hairy. Abdomen cylindrical, eight segments; in ♀ the abdomen is subfusciform; hypopygium small. Legs long and slender; hind femora stout and bare; hind tibiæ have minute lateral spines; spurs well developed. Wings minutely pubescent, parallel in repose; first longitudinal vein short, second ending much beyond half the length of the wing; fourth longitudinal, forked near its base, fore-fork ending just behind tip of the wing; fifth forked nearer base of wing, its fore-fork connected by a transverse veinlet with the third longitudinal vein before the fork of the fourth; the sixth and seventh veins short.

The metamorphosis is not known, but Winnertz* reared them from rotten wood. (*A. flavum*).

A. flavum, Wtz. = *P. rostrata*, Zett.

The *imago* is yellow. The thorax yellow, with three brownish stripes running longitudinally, clothed with black hairs. Proboscis, palpi and antennæ blackish-brown. Abdomen brown in the ♂; first and second segments yellow; sixth, seventh and eighth black; hypopygium light brown to yellow. In the ♀ the abdomen is pale brownish-yellow; third, fourth and fifth segments with black sutures; the seventh and eighth black; ovipositor light brown. Legs pale

* *Stett. Ent. Zeit.*, 1846, p. 18.

yellow; tibiæ pale brown; tarsi brown. The wings have a yellowish tinge. Length 2 to $2\frac{1}{2}$ lin. This is a rare species, and the only one of the genus found in England; the larvæ live in decayed wood.

B. Mouth not elongated like a beak.

GENUS *Platyura*, Mg.

Body long and narrow. Head roundish, small. *Proboscis short.* Eyes round; ocelli three, the costal one small. Palpi bent together; 4-jointed; first small, second and third large, fourth long and slender. Antennæ stout, not dilated as in *Ceroplatys*; 17-jointed, joints transverse. Thorax short. Abdomen depressed, cylindrical in ♂, seven segments. Legs long and slender, tibiæ without spines, spurs moderate. Wings are bare, and sometimes clouded; first vein curved forwards towards its tip; third forked, connected with the second at before one-third of length, when it forms a curve near its junction with the transverse; the upper prong of fork may end on the second vein or on the costal; fourth vein short, arises from the third, forked, fork long, petiole very short; fifth also forked, hind prong passing in a curve to the posterior border; sixth vein reaches the border; seventh small. Areolets thirteen.

The habits of this genus seem to resemble *Mycetophila*, most being found in woods and thickets, and the larvæ living upon fungi and rotten wood. At present very little is known about the larvæ. Meigen* mentions one, *P. marginata*, being found in a fungus. The species of this genus tabulate as follows:†

a. Fork of third longitudinal vein joins

second longitudinal vein - - - = *marginata*, Mg.

aa. Fork of third joins costal.

b. Fork rather long.

c. Fork curved - - - - - = $\begin{cases} atrata, F. \\ nigriceps, Wlk. \\ mycetophiloides, Wlk. \end{cases}$

cc. Fork straight - - - - - = *vitripennis*, Wlk.

bb. Fork short.

c. Wings spotted - - - - - = $\begin{cases} antica, Wlk. \\ fasciata, Ltr. \\ flavipes, Mg. \end{cases}$

* Meig., vol. i., p. 232, et Verh. Sch. Ges., 1837, p. 106.

† Walker, Ins. Brit., iii., 65.

cc. Wings unspotted - - - - = $\begin{cases} \text{unicolor, Wlk.} \\ \text{servula, Wlk.} \\ \text{discoloria, Mg.} \\ \text{concisa, Wlk.} \end{cases}$

P. marginata, Mg.

This is a black shining species. Proboscis and palpi tawny. Antennæ a little longer than the thorax. Abdomen long and black, with ferruginous markings in the ♀. Legs testaceous; tibiæ tawny, tarsi brown. Wings yellowish-gray, clouded with gray towards the tips and along the hind border, and with a slight brownish spot at the base of the fourth longitudinal vein; in the ♀ the discal brownish spot almost obsolete. Length $3\frac{1}{2}$ to 5 lin. Not common; found in woods, especially hazel woods.

P. fasciata, Ltr. = $\begin{cases} \text{ruficollis, Mg.} \\ \text{ochracea, Mg.} \end{cases}$

This is a tawny species, with short and slender brown antennæ, tawny at the base, as long as the thorax in the ♂, shorter in the ♀. Thorax with dark longitudinal marks. Abdomen with a black band on the fore-border of each segment; hypopygium brown; lamellæ and ovipositor yellow; hairs on the body black. Legs testaceous; tarsi brown. Wings with a pale yellowish tinge, and with a grayish sub-apical band, which is very obscure towards the hind border. Length 3 to $3\frac{1}{2}$ lin. Common in July.

P. concisa, Wlk.

Black. Proboscis and palpi tawny. Antennæ black, tawny at the base. Pectus and sides of the thorax piceous. Posterior borders of abdominal segment testaceous. Legs yellowish; tarsi dark brown. Wings grayish-yellow, unspotted. Length 2 lin. This seems to be a rare species, described shortly by Walker.

P. unicolor, Wlk., is also black, with brownish wings, paler in the disc towards the base, with black veins, ferruginous at the base. Legs ferruginous, tarsi black. Length 3 lin. Rare.

The other British species mentioned in the table are all, as far as our scanty knowledge goes, uncommon. *Flavipes* is, however, recorded as common at Glanville Wootton. This is a black species, with the hind borders of the abdominal segments testaceous. Length $1\frac{1}{2}$ to 2 lin.

Atrata is a very rare species, appearing in July and August.

Shining black, with a sub-apical brown spot, in front, on its gray wings. Length 3 to $3\frac{1}{2}$ lin.

Discoluria frequents lime trees. It is a tawny species. The anterior borders of the abdominal segments are brown, and the wings have a reddish-brown tinge. About $2\frac{1}{2}$ to $2\frac{3}{4}$ lin. (= *discolor*). Recorded from Glanville Wootton and Kingston.

Vitripennis is black, covered with hoary tomentum. Dale considers it a var. of *atrata*. Glanville Wootton.

GENUS *Ceroplatus*, Box = $\left\{ \begin{array}{l} \text{Rhagio et Sciara, F.} \\ \text{Platyura, Mg.} \end{array} \right.$

Head small. Proboscis short. Antennæ 16-jointed; broad and short, dilated; thorax oval. Palpi not bent together as in *Platyura*. Abdomen seven segments. Eyes oval, depressed in the inner sides; ocelli three, the central one small, nearly in a straight line. Legs longish, tibia with spines and spurs; femora and tibiæ short, rather thick, metatarsi long. Wings minutely hairy, short; often shorter than the body.

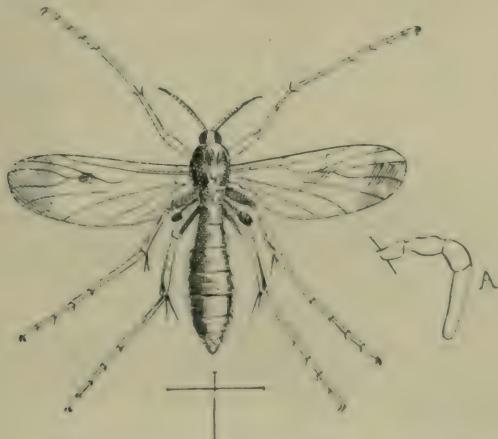


FIG. 29.—*Ceroplatus Lineatus*. A. Palpus.

The larvæ (Fig. 148) of this genus resemble in habits *Sciophila* larvæ, living in webs on the under surface of the pileus of tree fungi. Before the larvæ (which are white and slimy) pupate, they leave this web and spin a silken cocoon, near at hand; the cocoon is truncate at one end, and, according to Wahlberg,* closed with a lid. This observer also noticed the phosphorescent character of the pupæ, which even shine through the silken cocoon. Dufour† figures

* Acta. Holm. 1838.

† Ann. des. Sc. Nat., 2nd series, vol. xi., 1839.

the larvæ as having four large posterior segments and the remainder of the body, leech-like, marked by numerous annulations. Bosc* describes an American species, but talks of its body as having distinct segments. This does not answer to Dufour's description of the leech-like body.

There is only one species found in England, as far as we know.

C. lineatus, F. = *P. laticornis*, Mg.

Tawny. Thorax tawny, with three brown longitudinal stripes; pectus brown; metathorax brownish. Abdomen blackish-brown or black; there is a yellowish band with a spot on each side on the anterior borders of the third, fourth and fifth segments; hypopygium brown; ovipositor and lamellæ yellow. Head brown, proboscis and palpi yellowish. Antennæ broad, brown, testaceous at base, about as long as the head and thorax. Legs yellow; base of tibiæ and tarsi brown, also base of femora; metatarsi of the anterior legs longer than tibiæ; spines and spurs of the latter brown. Wings shorter than the abdomen; grayish, with apex brown, also a brown spot near the centre and one below at the posterior border of wing. Length $3\frac{1}{2}$ to $3\frac{3}{4}$ lin.

Walker describes *P. lineata* F., and *P. laticornis*. The latter is most likely the ♂ of *lineata*. He gives the length as 5 and 4 lin. *P. (C.) laticornis* is figured, pl. xxiii., fig. 5. This figure resembles *P. (C.) lineatus* F.

SECTION 5.—*Macrocerinae*.

Antennæ very long, filiform, 16-jointed; may be three times as long as the body, longer in ♂ than in the ♀. Body slender, pubescent. Head small, ocelli three, eyes nearly round. Labium forming two large pubescent lobes. Palpi 4-jointed, second smaller than the



FIG. 30.—Antenna of a *Macrocerina*, ♀.

first, fourth fairly long. Thorax short and elliptical. Abdomen cylindrical in ♂; elongate, fusciform in ♀. Legs long and slender; tibiæ without spines; their spurs very small. Wings moderately

* Dict. d'Hist. Nat., vol. iii., 1823. Figure of larva in the second edition of same, Tab. B. 21, fig. 4.

broad ; third longitudinal vein forked, arising from the second at before one-third of the length ; fourth emerges from the third at before half the length, near which it is forked ; fifth also forked, hind prong very much diverging from the fore one ; sixth extending to the hind border. Areolets thirteen.

These flies can at once be known by their elegant appearance and very long antennæ. They are fond of nettles in shady woods, and are often found resting on palings with the long antennæ extended. They are the most elegant of all this family. The characters of the section are the same as the genus, there being only one genus in this section.

The seven species found in Britain are tabulated by Walker, and as this seems the best method I can find I append it below :

α. Antennæ two or three times length of body.

β. Wings unspotted.

γ. Thorax striped - - - - = *vittata*, Mg.

γγ. Thorax not striped - - - - = *lutea*, Mg.

ββ. Wings spotted.

γ. Tips of wings not clouded.

δ. Thorax not striped - - - - = *stigma*, Curt.

δδ. Thorax striped - - - - = *centralis*, Mg.

γγ. Tips of wings clouded.

δ. Wings striped between the tip of the }
second and fork of the third vein = } *angulata*, Mg.

δδ. Wings striped before the tip of second }
vein - - - - - = } *phalerata*, Mg.

αα. Antennæ not longer than body - - - = *fasciata*, Mg.

M. vittata, Mg. = *M. dorsalis*, Curt.

This is a tawny species. Yellowish on the ventral surface. Palpi yellow. Antennæ blackish, yellow at base; as long as body. Thorax with three dark reddish stripes ; the median one long, the lateral ones short. The abdomen is tawny, with a dark brown dorsal stripe. Legs yellow ; tarsi brown. Wings grayish, with yellowish tinge at the costal edge. This is a common species, found resting on park palings. Length 3 to 4 lin.

M. fasciata, Mg.

This is a yellowish species. Thorax with three brown stripes ; lateral pair short. Abdomen yellow, with an interrupted dark brown dorsal stripe, and a brown band on the anterior border of each segment ; hypopygium brown ; ovipositor and lamellæ yellow. Head

yellow, brownish beneath ; palpi yellow ; antennæ shorter than the body ; brown, yellowish at base. Legs long, yellow ; tarsi brownish-black, with black hairs. Wings grayish. Length $2\frac{1}{2}$ to $3\frac{1}{2}$ lin.

Walker mentions a variety with testaceous bands on the antennæ.

The other five British species are all fairly common. *M. centralis*, Mg., *angulata*, Mg. = *vittata*, Macq., and *stigma*, are described in Curtis's 'British Entomology' (637, 3), (637, 2) and (637, 6). 1837.

M. phalerata, Mg. (Verh. d. Zool. Bot. Ges., xiii., 683, 13.)

M. lutea, Mg. (Meigen, System. Beschr., i., 223, 1.)

M. maculata, Mg., is also described by Curtis (B. E., 637, 4), but is placed amongst the reputed species by Verrall.

SECTION 6.—*Bolitophilinæ*.

This section again only includes one genus, so we may combine the characters of genus and section together.

Body slender. Head small. Eyes round and prominent. Ocelli three, nearly in a straight line. Labium short and broad. Proboscis short. Palpi 4-jointed, cylindrical ; first, second and third joints short, fourth long and slender. Antennæ 16-jointed, slender, setiform, shorter than body ; apex attenuated, but not segmented ; pubescent in ♂, longer than ♀ ; in the latter they are bare. Thorax long. Abdomen long and attenuated ; nine segments, last segment small, cylindrical in ♂ ; fusciform in ♀ ; eighth and ninth segments very small. Legs long, very slender ; tibiae with no spines or spurs. Wings minutely hairy ; third longitudinal forked, *upper branch nearly at right angles, joining second vein near its tip* ; fourth longitudinal vein emitting a transverse veinlet which joins the third, forked immediately after this ; sixth and seventh do not reach the border. Areolets fourteen. These gnats appear almost all the year, and are found in shady and damp places ; they are often met with in winter, especially on mild days, even when snow is on the ground. Walker says they "are allied to *Dixa* and *Trichocera*," but the neuration is entirely distinct from both.

GENUS *Bolitophila*, Mg. = $\left\{ \begin{array}{l} \text{Macrocerata, Klt., Mg.} \\ \text{Messala, Curt.} \end{array} \right.$

There are four species in the genus, two of which are found in England and two in Russia.

B. cinerea, Mg.

This is a grayish-black gnat, with testaceous palpi. Pectus also testaceous, and so are the antennæ at the base. Legs yellowish, tibiae and tarsi blackish. Wings with a small gray spot on the costa

at the tip of the radial vein. Length $2\frac{1}{2}$ to 3 lin. Common in most places.

B. fusca, Mg. = $\begin{cases} B. maculipennis, \text{ Wlk.} \\ M. hybrida, \text{ Mg.} \\ Messala Saundersii, \text{ Curt.} \end{cases}$

This is a larger species than the former. Schiner describes it as brown, Walker as ferruginous; the only one I have seen is brownish. Thorax with three dark longitudinal stripes. Head brown, palpi pale or yellowish. Antennæ brown, pale at the base.

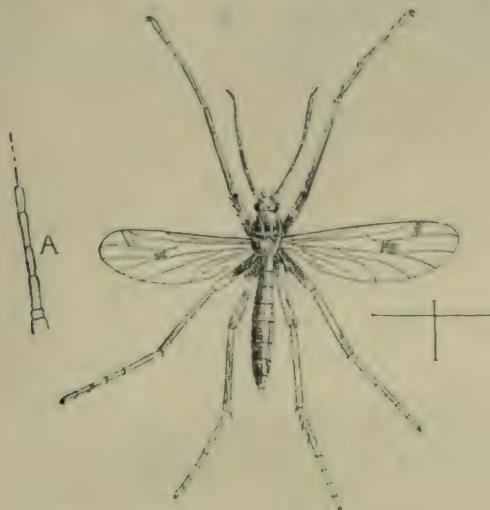


FIG. 31.—*Bolitophila fusca*. A = base of antenna enlarged.

Legs yellow, tibiæ and tarsi brown. Wings pale, grayish-yellow in colour, with a gray spot at the tip of the praebachial areolet, and a large brown spot by the costa at the tip of the second longitudinal vein. This is a rarer species than the former, and may be known by its lighter colour and the presence of the spots (2) on the wings.

The habits of the larvæ of this genus seem to resemble those of *Mycetophila*. "The larva spins a cocoon which remains on the surface of the ground, or among the fragments of the decayed fungus."*

SECTION 7.—*Mycetobinæ*.

Antennæ 17-jointed, not long. Brachial vein long. Sub-costal rudimentary, third, fourth and fifth veins forked.

* Pro. Ent. Soc. Phil., 1862, p. 13, reprint. Osten-Sacken.

GENUS *Mycetobia*, Mg.

Body rather short. Head round, flat above. Eyes reniform. Proboscis and palpi short; the latter is 4-jointed, first joint small, second long, third small and fourth long. Antennæ 17-jointed, end joint very small. Abdomen composed of seven segments. Legs stout; tibiae without spines, very short spurs. Wings broad, small hairs; brachial and cubital (third) forming a sessile fork; fourth longitudinal vein forked near the tip of the wing, and emerging from the pobrachial transverse veinlet; fifth forked, forming the præ- and pobrachials; sixth and seventh incomplete. Areolets thirteen, viz., the humeral, radical, sub-costal, radial, *præbrachial united to the pobrachial*, cubital, sub-apical, anal, sub-anal, sub-axillary, axillary and three extero-medials.

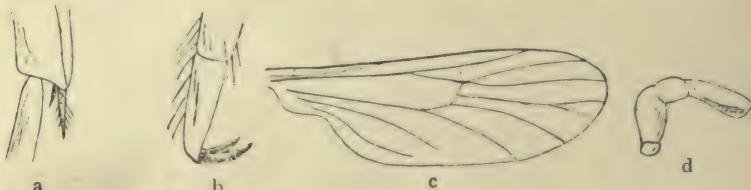


FIG. 32.—*Mycetobia pallipes*. a = posterior tibia and spurs; b = last tarsal joint and ungues; c = wing; d = palpus.

The larvæ feed on fungi and rotten wood. Macquart reared them from larvæ found in the detritus of elm wood. The only species of this genus inhabits woods, and may be taken at rest on tree stems, especially decayed ones, and those covered by lichens.

M. pallipes, Mg.

Black. Abdomen brown. Head and antennæ black; palpi yellow. Legs yellowish, tarsi brown. Wings limpid, black veins. Spurs yellow. Inhabits decayed tree trunks.

GENUS *Ditomyia*, Wtz. = { *Mycetobia*, Mg.
Symmerus, Wlk.

Body slender. Head roundish, small. Proboscis and palpi short; first joint small, oval; second long, third and fourth small. Antennæ 17-jointed, slender, compressed; first joint cyathiform; second transverse, the rest ovate-cylindrical; the seventeenth small. Eyes roundish; ocelli three, central one small. Thorax oval. Abdomen seven segments, long, compressed, widened at the tip in the ♀, linear in the ♂. Legs long; posterior tibiae longer than tarsi; tibiae armed by short spines and fairly long spurs. Wings hairy, fairly

broad ; first longitudinal rudimentary ; second longitudinal not very long ; upper fork of third passes much beyond the second, hind fork

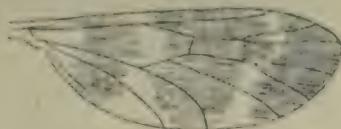


FIG. 33.—Wing of *Ditomyia fasciata*.

ending at the tip of the wing ; fourth arising from the third nearer the apex than the connection with the third and second ; the sixth (anal vein) extends to the border. The larvæ live in *Boleti*. This genus seems to be doubtfully represented in Britain. There are only two species, one of which is found in England.

D. fasciata, Mg. = *trifasciata*, Wtz.

Yellow. Thorax with three brown stripes, the lateral pair shortened in front ; a brown spot on the sides. Abdomen blackish-brown, sutures and genitalia light brownish-yellow. Palpi brownish, the last joint shorter than the other three. Antennæ brown, yellow at the base. Legs brownish, the femora yellow ; tarsi brown. Wings grayish, with three brownish bands (transverse), one at the apex, one in the centre, the third towards the base. Length 2 to 3 lin.

GENUS *Plesiastina*, Wtz. = $\begin{cases} \text{Mycetobia, Mg.} \\ \text{Symmerus, Wlk.} \\ \text{Ditomyia, Wlk.} \end{cases}$

Head, thorax, and abdomen and legs as in *Ditomyia* ; palpi 4-jointed, the first joint small. Antennæ 17-jointed, basal joint smaller than the others ; the last joint small. Eyes reniform ; ocelli three, the middle one small. Wings as in *Ditomyia*. The larvæ live in *Boleti* and rotten wood.

P. annulata = $\begin{cases} \text{Ceroplatus flavus, Zett.} \\ \text{P. vittata, Wlk.} \end{cases}$ *

Testaceous. Palpi tawny ; antennæ brown, testaceous at the base. Thorax with three brown stripes, the middle one longest, broadest in front. Abdomen with a brown dorsal stripe. Legs yellowish, tarsi brown. Wings grayish-brown. This is a rare insect.

* I believe *vittata*, Wlk., to be synonymous with *annulata*, Mg., and therefore the same as Zetterstedt's *Ceroplatus flavus*.

SECTION 8.—*Diadocidinae*.

Body bare, short. Head round, flat above, hairy in front. Proboscis short; palpi 4-jointed, slender. Antennæ 17-jointed, stout, cylindrical, last joint small. Eyes reniform. Ocelli three, the central one not much smaller than the others. Thorax nearly round,



FIG. 34.—Wing and palpus of *Diadocidia ferruginosa*.

scutellum small. Abdomen 7-ringed, cylindrical. Legs stout, pubescent; tibiae slender, armed with spurs at the tip; posterior tibiae with slender spurs. Wings broad, hairy, parallel in repose; first longitudinal vein very small; second longitudinal vein springing from the base of the first and ending before the tip of the wing; third longitudinal vein simple; fourth forked, springing from a transverse angular veinlet, sixth reaches the border. Metamorphosis unknown.

GENUS *Diadocidia*, Ruthé = $\begin{cases} Macroneura, \text{ Macq.} \\ Sciara, \text{ Zett.} \end{cases}$

This is the only genus in this section.

D. ferruginosa, Mg. = $\begin{cases} D. flavicans, \text{ Ruthé.} \\ D. Winthemi, \text{ Macq.} \\ S. testacea, \text{ Zett.} \end{cases}$

Tawny. Thorax with three brown stripes. Abdomen yellow or yellowish-brown; apex dark. Head and antennæ brown, basal joints, palpi and proboscis yellow. Legs yellow, brownish tarsi; posterior tibiae longer than tarsi. Wings grayish, with brownish veins and gray hairs. Length $1\frac{1}{2}$ to 2 lin. This seems a doubtful British species. Walker says it has been found by Mr. Haliday at Killarney.

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18. Dipt. du Nord. Macquart.
19. Ins. Brit. Diptera, 1851. Haliday (*Epidapus*), (*Azana*).
20. System. Beschr., i., 1818. Meigen.
21. Illiger's Magaz., ii., 1803. Meigen.
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23. Brit. Ent., 365, 1831 (*Leptomorphus*). Curtis.

CHAPTER VI.

THE BIBIONIDÆ.

THIS is a small family of usually dark flies. The body broad, fairly large, 7-9 segments. Prothorax conspicuous; scutum of mesothorax undivided. Wings broad, with no discal areolet. Antennæ seldom longer than head in both sexes; thick, cylindrical, moniliform; composed of from 8 to 12 joints. Palpi 3 to 5 jointed (apparently only one large joint in *Scatopse*). Eyes large, round or reniform, often hairy; contiguous in ♂, small in ♀. Ocelli three. Legs short; tarsi armed with *three pulvilli*; tibiæ having often large thick spurs.

The following are synonymous with *Bibionidæ*.

Bibionidæ =
$$\begin{cases} \text{Bibionides, Westwood.} \\ \text{Tipularie muscaformes, Mg.} \\ \text{Bibionites, Newne.} \\ \text{Hirteides, Bilb., Zett.} \\ \text{Scatopsides, Zett.} \end{cases}$$

The Bibionidæ are divided in two sections, and the genera tabulate as follows :

A. SCATOPPINÆ. Posterior basal cell wanting.

Anterior tibiæ of usual shape. Metatarsus of the hind legs shorter than the rest of the tarsal joints together. Legs moderately thick. Third longitudinal not forked - - - = *Scatopse*.

Anterior tibiæ of usual shape. Metatarsus of the hind legs as long or longer than the rest of the tarsal joints together. Legs slender = *Anarete*. Anterior tibiæ with a single spine at the apex = *Aspistes*.

B. BIBIONINÆ. Posterior basal cell present.

Anterior tibiæ with a wreath of spines at apex = *Dilophus*. Anterior tibiæ with a single spiny process at the end - - - - - = *Bibio*.

The members of this family frequent meadows, and appear in great numbers, such as *Bibio*. They mostly appear in the spring, but some are autumnal insects, and they may even appear in midwinter (*Dilophus*). This latter genus also occurs in great abundance in hop fields, where the "fever fly," as it is called, does great damage. Haliday also says they appear plentifully on sand-hills. The genus *Scatopse* may be found in outhouses, on walls and windows, while some frequent flowers (*S. notata*), and others are abundant on trees, feeding on the honeydew of the *Aphis* (*S. picea*). Many appear in swarms or clusters. "In 1862 it (*D. febrilis*) was recorded as hanging in millions on flowers, and in bunches on grasses."* It is not uncommon to find clusters of them under the bark of trees. In 1887 I noticed this character in particular in a *Scatopse* at Hastings. It appears to be the females that have this gregarious habit; the males may usually be found hovering about in the air; their flight is slow and heavy. Some of this family are double-brooded, such as the common fever-fly, which appears in spring and autumn, but the majority seem to have only one brood. Although it is a small family, and evidently on the decline, the number of specimens is very great. They are very abundant all over England, as many as forty-two species being recorded, nearly all of which are fairly common and some appearing in immense numbers.

The *larvæ* of this family are cylindrical or fusciform maggots, living in the earth, in dung, stems of plants, and at the roots (*Dilophus*) destroying the vegetation; the grass roots and corn are especially attacked and destroyed (*Bibio* and *Dilophus*), others (*Scatopse*) feed on decaying animal and vegetable substances. The maggots occasionally do great damage, as in the case of the fever-fly (*Dilophus febrilis*), to be described later. The *larvæ* are furnished with twenty spiracles and with transverse rows of hairs; generally whitish-brown in colour, with brown head, which is armed with two biting mandibles (*Bibio*).

The *larva* of *B. pomone* (Fig. 1, Plate iii.). This maggot when full-grown is about three-fourths of an inch to an inch long, of a chestnut brown colour and somewhat flattened dorso-ventrally. The head is much smaller than the body segments and densely chitinous, ornamented with three pairs of large bristly hairs and several smaller ones. The body is divided into twelve segments, the first being narrow and having two rows of fleshy tubercles; the remaining segments are large, and each one with a single row of six tubercles, the twelfth

* *Man. Inj. Insects*, p. 129.—Ormerod.

segment somewhat smaller and having two black dots upon its dorsal surface. Several tubercles surround the base of anal segment. There are also two lateral tubercles on each segment, and two rows of four each on the ventral surface. They may be found in May and June under wet moss ; they turn to pupæ during the latter end of June.

In *Scatopse* the larvæ are fusciform, legless, as in the others, with two short points on the thorax at the side, and also on the eight abdominal segments at the base ; the last segment is terminated by two divergent setæ.

The pupæ are naked, enclosed in an oval cell ; thorax gibbose, markings of wings and legs very short, usually pale in colour (*Dilophus*).

The pupa of *Bibio* (Fig. 2, Pl. iii.) is dark brown, and has a curious shrivelled appearance, about one-third of an inch long and very broad. The anal segment is very small, and has two divergent spines on its dorsal surface. The wing cases are small and closely surround the legs. The thoracic portion is much elevated. The flies hatch during July. I have to thank Mr. Bignell for the loan of the specimens figured.

Their range in space is wide ; they occur abundantly from Scandinavia to the tropics, and in America they appear in great numbers, and do considerable damage to crops. Their geological range is limited, but no insects occur so abundantly in a fossil condition as the *Bibionidae*.* They appear first in the tertiary beds ; there are records of their appearance in the mesozoic, but the species are very doubtful, and we cannot place the true record of their appearance further back than the tertiary period. But in the tertiary epoch they are the most abundant insects ; they are not, however, rich in species, but what do occur are found in great numbers. They are rare in amber. Loew found the genera *Dilophus*, *Plecia* and *Scatopse* ; *Bibio* is strangely enough wanting. *Plecia* also occurs abundantly in the rock formations in Aix, Oenigen, Auvergne, Wyoming, etc. *Bibio* occurs most abundantly in the rocks, between forty and fifty species have been described from various places in Europe and America. There seem to be some extinct genera found, such as *Epiplecia*, Siard, which occurs at Covent ; also *Protomyia* and *Bibiosis*, genera formed by Heer, but which are considered by Loew not

* Note sur les Bibionides fossiliis. Bull. Sc. dép. Nord. T. i., Lille, 1878 ; also Bibioniden aus der rheinischen Braunkohle Von. Rott. Pal. Band. Siard. xiv. Taf. 8 and 9, 1865. Heyden, etc.

to be true genera ; the latter naturalist unites the species of Heer's two extinct genera to *Plecia*. The genus *Penthelria*, Mg., also seems to be represented in a fossil state at Aix.

GENUS *Anarete* = $\left\{ \begin{array}{l} Lestremia, \text{ Mg.} \\ \text{Sciara, Zett.} \end{array} \right.$

Head semicircular, small. Ocelli three. Proboscis projecting ; palpi 4-jointed, the last joint not longer than the others. Antennæ short, 9-jointed, hairy ; first joint large, second larger than third. Abdomen 7 to 8 jointed ; ♂ genitalia sometimes large and projecting. Wings longer than the abdomen, bare ; third and fifth longitudinal veins simple ; fourth forked ; first simple. Legs slender, femora thin ; tibiæ slender, without spurs. Fig. 3, Pl. iii.

A. albipennis, Mg. = $\left\{ \begin{array}{l} A. candidata, \text{ Hal.} \\ L. albipennis, \text{ Mg.} \end{array} \right.$

Black, shiny ; antennæ pale black. Legs yellowish, in the ♂ somewhat longer than in the ♀ ; hind tibiæ and tarsi white. Wings milky ; veins pale, except the costal and sub-costal, which are tawny in living specimens. Length 1 lin. Rare.

GENUS *Scatopse*, Geoff. = $\left\{ \begin{array}{l} Tipula, \text{ L. F. Deg.} \\ Ceria, \text{ Scop.} \\ Aspistes, \text{ Ruthé.} \\ Hirtea, \text{ F. Mg. et Zett.} \end{array} \right.$

Body small, long and shiny. Head roundish, narrower than thorax. Thorax convex, hairy ; scutellum small. Abdomen with 7 or 8 segments, depressed ; extremity of ♀ truncate (generally), the ♂ genitalia usually distinctly visible. Legs comparatively short and somewhat thick ; anterior femora distinctly thickened, tibiæ unarmed. Palpi very short, hidden ; the last joint appearing large, and almost seeming as if the palpi were one-jointed. Proboscis slightly projecting. Antennæ 10-jointed ; second joint long, cup-shaped ; last joint elongated, oval ; middle joints short, transverse. Wings long, broad, bare ; longer than abdomen. Fig 4, Pl. iii.

The larvæ, which are long, fusciform, apodous grubs, live in decaying vegetable matter and human excreta, sewers and open drains. They are terminated by two elongated divergent setæ

S. notata, L. = $\left\{ \begin{array}{l} \text{Tipula latrinarum, Deg.} \\ \text{T. scatopse, Gmel.} \\ \text{T. albipennis, F.} \\ \text{S. decennodia, Scop.} \\ \text{S. nigra, Geoff.} \\ \text{S. punctata, Mg., Zett.} \end{array} \right.$

Black and shiny. The thorax and scutellum, and sometimes the abdomen, have a whitish, yellow or yellowish-brown stripe; this marking is not, however, always present. Antennæ deep black. Legs deep black; tarsi black or brown; the metatarsus of the hind leg in the ♂ is very short, hardly half as long as the next tarsal joint. Halteres yellowish-brown. Wings limpid; the third longitudinal vein joins the costa at its extremity, viz., at about two-thirds of the length of the wing; the costal, first, second and third veins dark, rest pale; the fourth forked, petiole of fork long and curved gently downwards, arising from the third slightly nearer the base than the transverse veinlet; sixth vein very undulating. There are slight indications of a transverse veinlet running from the upper branch of the fork to the third vein. Length 1 to $1\frac{1}{2}$ lin.

This is an abundant species, and may be found from May to September in very varied places, such as on flowers and on windows, especially in conservatories. I have also found them very abundant flying over open drains and foul ditches in Cambridgeshire. At certain times this fly is very abundant and appears in swarms. Walker says: "They occasionally dwell in clusters beneath the bark of pales." The larvae live in rank farmyard manure and also in decaying vegetable matter. Large numbers of this fly may be taken flying over the former. I have especially noticed this in the early spring.

S. scutellata, Lw. = *S. picea*, Hoff., Wlk.

Deep black; thorax yellowish on each side, also sometimes the sides of the abdomen. Antennæ black. Legs blackish-brown. Bases of tibiæ pale. Halteres pale. Wings limp; second longitudinal vein about one-third length of wing; third joins costal at its apex on the upper border of the wing. The above veins tawny, dark. Fourth forked, fork narrow; eighth nearly straight; sixth very slightly undulating and a rudiment of a seventh vein present. Length 1 to $1\frac{1}{2}$ lin.

An abundant species, and appears often in great swarms in the oak and other trees, feeding on the honeydew of the green fly in the autumn.

S. flavicollis, Mg. = *S. ochracea*, Mg.

Tawny; head black; antennæ at base yellowish; palpi dark brown; thorax tawny; scutellum tawny or brownish; sides of the breast light. Abdomen black above, except the hind borders of the segments, anal segment pale brown. Legs light brown; tarsi darker. Halteres yellowish. Wings: costal short; first, second, and third veins tawny; the fork of the fourth very long; petiole short; transverse veinlet small; sixth scarcely undulating. Lower veins all pale. Length 1 to $1\frac{1}{4}$ lin. This is an autumnal species, and frequents the flowers of ivy, and also found with *picea*.*

S. Albitarsis, Zett.

This is a black species, with long body and milky wings, with white tarsi. Length $1\frac{1}{4}$ to $1\frac{1}{2}$ lin. Common.

S. transversalis, Lw.

Black. The veining of the wings easily distinguishes this fly. The second vein short and curved abruptly upwards to the costa; the third undulated, transverse veinlet between them thick; the fourth forked, petiole short and fork long, arising nearer the base of the wing than the transverse veinlet; the *upper prong of the fork united to the third by a long transverse veinlet*, the prong angulated at the origin of the veinlet; fifth nearly straight; sixth bent abruptly to posterior border and undulated. Length $\frac{3}{4}$ to 1 lin. Verrall records it as occurring freely on a tree near Thetford, June 17, 1880.

S. brevicornis, Mg. = *S. septemnodia*, Schrk.

Dark black; antennæ very short and deep black; legs and halteres also deep black. Wings milky; second and third longitudinals short, running close together and curved up abruptly; costal very short; fourth forked near its apex, petiole of fork very long; eighth nearly straight; sixth with an abrupt undulation. This fly is distinguished at once by the shortness of the second and third longitudinals and by the curious short fork of the fourth. Length $\frac{1}{2}$ to $\frac{3}{4}$ lin. A fairly common insect.

S. halterata, Mg. = $\begin{cases} S. albipennis, v. Roser. \\ S. minuta, Zett. \end{cases}$

Black; antennæ thick, long; proboscis and palpi black; halteres white. Wings whitish; second longitudinal short, about one-fourth length of wing; third running near it, and ending at about half the

* Walker mentions a variety with disc of thorax black.

length of wing ; fourth longitudinal forked ; fork long ; the upper prong apparently *not united to the fork* ; fifth curved to posterior border ; sixth very undulated. This is a very small species—not more than $\frac{1}{2}$ to $\frac{2}{3}$ lin. in length. Found in rough herbage and grass. Zetterstedt* says concerning this species : "Speciatim in *Alopecuro geniculato*," in July and August.

S. bifilata, Hal.

Black ; thorax with pale pubescence, shiny. Primary veins pale yellow. Legs piceous black ; tibiae luteous, blackish tips ; hind tibiae with blackish band across middle. Sub-costal vein less than one-third length of wing. Recorded from Ireland by Haliday.

S. incompleta, Ver.

Small species ; black ; abdomen shining ; distinct venation ; second vein extending far beyond the middle of costa ; curves into costa at its end. The forked vein starts at the transverse veinlet, forks about same length as peduncle ; both vanish before they reach edge of wing. Wings very dark. Appears in August.

S. pulicaria, Lw.

This species has clear wings and short peduncle ; complete forks.

S. infumata, Hal. = *S. fuscinervis*, Lw.

Black, with gray wings ; sub-costal vein ends a little beyond one-third of the length of the wing ; radial ending with costal at beyond two-thirds of the length. Tibiae white towards base and at tips ; tarsi white, black towards tips. "Rare in moist groves." Described by Haliday in *Ent. Mo. Mag.*, i. 159, 1833.

S. subnitens, Ver.

Black, long, shining thorax ; wings broad ; forks of the forked vein widely diverging at the tip. A very rare species, found in May, and recorded by Verrall from Denmark Hill in 1868, and not again until 1873.

S. recurva, Lw.

Wings narrower than in subnitens, the thorax dull, and the forks not diverging so greatly. A common garden species.

S. minutissima, Ver.

A very minute species appearing in June. Dull black and narrow. Thorax brownish at sides and clothed by pale pubescence. Abdomen very depressed ; legs brownish ; tarsi, halteres, and short palpi dirty dull white. Tibiae all widen towards the tip. Occurred in profusion at Pagham Harbour in 1876.

* Ins. Lapp., 801.

S. inermis, Ruthé = *S. soluta*, Lw.

A widespread and common species. Black, with costal, sub-costal, and radial veins testaceous, others pale, almost white. First vein ends at a little beyond one-third length of wing; second ends at about two-thirds and far from the border. Legs blackish brown, pale towards the tips. Verrall records it from Exeter, Cambridge, Windermere, and Gairloch.

S. clavipes, Lw.

A shining black species, with thick, long antennæ and with stout, black legs. Radial vein ending with costal at much before two-thirds of the length of the wing.

The following are also British species, viz., *S. geniculata*, Zett. (D. Scand., ix. 3401-5), *S. tristis*, Zett. (D. S., ix. 3404, 8), *S. talpæ*, Ver., *S. coxendix*, Ver., and *S. platyscelis*, Lw.

GENUS.—*Aspistes*, Mg. = *Arthria*, Kirby.

Small; body shining, nearly bare, broad and short. Head roundish, small. Proboscis and palpi not seen or very slightly protruding. Eyes remote, small; ocelli three; antennæ 12-jointed, cylindrical, a little longer than the head; joints transverse cyathiform; last joint large, hairy; third joint small, joints gradually getting larger. Thorax convex, broad. Scutellum small, transverse. Abdomen broad, eight segments, depressed. Legs stout and short, fine pubescence; coxæ large; fore femora very thick, with a few bristles on the ventral surface; fore tibiæ with long apical spine; short spurs on the hind tibiæ; metatarsus of hind legs as long as the tarsal joints together. Wings wide, bare, hyaline; first longitudinal vein rudimentary; second or radial dark, and ending before half the length of the wing; third longitudinal vein curved and ending on the anterior border before two-thirds of the length; fourth and fifth simple and arising from the third; the sixth and seventh veins distinct, and meeting the border. The latter vein often has a distinct angulation. Schiner* says concerning the metamorphosis: "Ueber die Metamorphose ist mir nichts Positives bekannt geworden; v. Winthem vermuthet, dass die Larven an *Tussilago petasites* oder *spuria* leben dürfen; sicher und durch Zellers und Scholtz's Beobachtungen ausser zweifel gesetzt ist, dass die Fliegensich besonders häufig an sandigen Stellen, wo die genannten Pflanzen nicht vorkommen, vorfinden." —Fig. 5, Pl. iii.

* Schiner, Die Fliegen, vol. ii., p. 348.

A. berolinensis, Mg. = *A. pullus*, Hal.

Shining black. Head, palpi, and antennæ black; thorax slightly pubescent and somewhat shiny, black. Legs testaceous; femora deep black; tibiæ and tarsi testaceous; apex of tibiæ black. Halteres black. Wings limpid; costal black; first and second longitudinal veins black; second incrassated at its junction with the costal. The other veins colourless. Length 1 to $1\frac{1}{4}$ in. This appears to be a rare species from the few records. This is the only British species.

GENUS.—*Dilophus*, Mg. = $\begin{cases} \textit{Tipula}, \text{L.} \\ \textit{Hirtea}, \text{F.} \\ \textit{Bibio}, \text{Lat.} \end{cases}$

Body stout and elongated. Head longish in ♀, broad in ♂. Mouth parts: Labrum short; lingua lanceolate; labium bilobed and hairy. The antennæ 11-jointed, short, sub-moniliform, porrect; joints of the first seven transverse, cyathiform, the third being large and petiolate; first and second generally very hairy; eighth, ninth, tenth, and eleventh forming one elliptical mass. The palpi are long, 5-jointed, with a few large hairs. The third joint is dilated; the fourth and fifth elongated, slender. Eyes in the ♂ round and hairy, large and contiguous; in the ♀ small and oval. Ocelli three; usually placed far back on the head in the ♀ and squeezed into a small triangular patch at the hind border of the head in the ♂. Thorax very convex, covered with black hairs and having two transverse ridges in front. Abdomen hairy; seven to eight segments. Legs stout; anterior tibiæ crowned at the extremity with a wreath of short teeth-like spines and with two or three spines in the middle of the tibia on the outer border; tarsi decrease in size, last joint longer than the preceding one, rounded at the apex, and bearing two unguis and three pulvilli, all much the same size, with a few long bristles and numerous small hairs; femora and metatarsi hairy; tibiæ generally nude. Fig. 7 Pl. iii. Wings broad and long; costa ending hardly in front of the tip of the wing; first longitudinal vein short, but perfect; second ends a little further along the wing; third simple; fourth forked, joined to fifth, which is also forked, by a transverse veinlet; sixth and seventh indistinct; costal, first, second, and third dark; remainder pale. The metamorphosis will be described in *D. febrilis*, L.

Dilopus febrilis, Linn. (the Fever Fly) = { *D. vulgaris*, Mg.
D. spinatus, Müll., Wlk.
D. nigrinus, Oliv.
D. forcipatus, Lat.
T. marci, Schk.

As this is one of our so-called insect pests, we deal at greater length with this species. The imago is black; ♂ shining black; eyes hairy; proboscis and palpi blackish. Wings whitish, brown along the costa, and the stigma blackish; veins near the costa black; remainder white. Abdomen quite black. Legs black; tibia at its base armed with a circular row of thick spines, one very large. The edge of the tibia has also a pair of spines and one single one developed on the anterior legs; femora hairy and broad in the anterior legs, narrow in the posterior; metatarsi short, second and third tarsal joints small, with a few large bristles; last joint long and rounded at the tip, finely hairy; unguis long and dark; pulvilli three and yellowish, the edges apparently striated. The ♀ has blackish-brown wings, paler along the hind border; stigma and veins almost black. Eyes not contiguous, as in the ♂. Abdomen brown. Length 2 to 3 lin.



FIG. 35.—*Dilopus febrilis*.—The Fever Fly.
(From Miss Ormerod's Manual Inj. Ins.)

Walker says concerning this species that it is generally distributed "in profusion everywhere—most so on sandhills. Appears in conservatories even during a severe frost in the middle of winter" (Hal. MSS.). This latter statement I cannot verify. It is a common insect at my home (Kingston-on-Thames), and large numbers appear in the grounds and conservatories; but although I have often searched for them in winter I have not been successful in finding any *live* specimens later than November or the first week in December. Lots may often be found at all times in the cobwebs. In grape-houses they seem particularly abundant. This "fever fly," which is two-brooded, occasionally appears in vast swarms. "It

appeared amongst the hop-cones at Rainham, in Kent, in 1882. It has been observed in enormous numbers off the Norfolk coast. In 1862 it was recorded as hanging in millions on flowers and in bunches on grasses" (Ormerod, *Man. Inj. Insects*, p. 129). In April, 1884, Miss Ormerod had the larvæ sent her from Sittingbourne, where they were attacking the hops and doing considerable damage by eating away the roots; and a few days later she continues to tell us it was reported from Sharsted that "These grubs appear to be doing much damage to the hop plants by gnawing away the original plant, and considerable quantities of them may be found even at one stem." They also appear to do damage to the roots of grass and corn and garden plants. Curtis also notices that the maggots are found in cow and horse manure. I have myself bred many from the latter, and think it most probably their true home. If so, they are readily spread, in manure, to the fields and gardens, as so many other insect pests are.

The first brood appears in May and June, the second in the autumn. The larvae are white, cylindrical, legless grubs, with brown head and numerous hairs, about a quarter of an inch in length. The pupæ are pale brown; whitish, according to Miss Ormerod.

D. albipennis, Mg. = *Hirtea albipennis*, Zett.

This is also a black insect, but the tibiæ and tarsi are testaceous (Meigen, *Sys. Beschr.*, vi., 315, 6, § 830).

D. humeralis, Zett.

This is another British species. Black; the sides yellow and the wings having a brownish-yellow tinge. Legs reddish. Length $2\frac{1}{4}$ to $2\frac{1}{2}$ lin. (Zetterstedt, *Dip. Scan.* ix., 3393, 3, 1850).

GENUS.—*Bibio*, Geoff. = *Hirtea*, Zett., F.
Tipula, L., Deg., Schrk.

The body stout, elongated, fairly large. Head elongated in ♀, broad in ♂. The mouth parts are as follows: Labrum short, triangular, hairy at apex; lingua long and lanceolate, hairy at apex; labium very hairy, bilobed. Eyes hairy, large and contiguous in the ♂, remote in the ♀. Ocelli three. Palpi 4-jointed; first joint small; second linear, longer than third; fourth small; fifth longer. Antennæ 7 to 9-jointed, sub-moniliform, and short; first and second joints hairy; ninth round; the rest are transverse and minutely pubescent. Pl. iii. fig. 6 c. Thorax elongate, oval. Abdomen with nine segments, hairy, blunt apex in the ♂, pointed in ♀. Legs stout, moderately long; anterior femora and tibia short, the latter having a large apical spine and a small thick spur; posterior tibiæ with two apical

spurs; metatarsi short; tarsi decrease from first to fourth; fifth longer; unguis and three pulvilli large. Pl. iii., fig. 6 n. Wings large and broad. The costal does not reach the tip of the wing. First longitudinal vein small and faint; the second longer and more distinct; the third longitudinal simple, proceeding from the angle of the praëbrachial transverse veinlet and meeting the costa at its tip; fourth and fifth longitudinal veins forked.

The members of this genus are nearly all found in the spring and early summer, the females are more sedentary than the males; the former may be taken in meadows and borders of woods by sweeping, the latter are more often taken on the wing. The genus is represented in Britain by fifteen species.

B. pomonæ, F. =
$$\begin{cases} \text{Tipula Marci fulvipes, De Geer.} \\ \text{T. pomonæ, F. and Donovan.} \\ \text{Hirtea pomonæ, F., Mg. et Zett.} \end{cases}$$

This is a fairly abundant species; black and clothed with long black hairs; the femora reddish, the rest of the legs black. Wings whitish-gray, the veins near costa and the stigma blackish-brown. The ♀ is covered with short black hairs, and head narrower than ♂. Length 5 to $6\frac{1}{2}$ lin.

B. Marci, L. St. Mark's Fly. =
$$\begin{cases} \text{Tipula Marci, L.} \\ \text{T. brevicornis, L.} \\ \text{T. febrilis, Schrk.} \end{cases}$$

This is a deep black species, the legs being entirely black. The whole body is clothed with black hairs. In the ♂ the wings are whitish, almost opalescent, but blackish costa and with blackish-brown stigma and brownish or black veins near costal region, the lower veins pale. In the ♀ the wings are blackish and very dark along the costa; the stigma and veins near costa are also blackish. Length 4 to 5 lin. This is a very common species, and appears about St. Mark's day, hence the name. Pl. iii., fig. 6 A.

B. hortulanus, L. = *T. hortulanus*, L.

Black; ♂ thorax with black hairs, sides of breast and abdomen with gray hairs, black on the last segment. Head, proboscis and palpi blackish-brown. Legs black. Halteres black; wings grayish, brown along the costa; stigma oblong and blackish-brown. In the ♀ the thorax (on dorsal surface) and the abdomen tawny, prothorax and sides black. Head, antennæ and palpi black. Legs black. Wings brownish-yellow, costa dark brown. Hairs on the posterior tibia tawny. There seem to be several varieties of this species, which is a common vernal insect. Length 3 to 4 lin.

B. Johannis, L. St. John's Fly =
$$\begin{cases} B. rufipes, Mg. \\ Tipula pyri, F. \\ Hirtea praecox, F. \\ T. pomona, Schrk. \\ H. hyalina, Mg. \end{cases}$$

This is a common and widely distributed species, occurring about St. John's day, hence its name. The ♂ is black with black hairs; legs testaceous, tarsi dark at the tips; antennæ, palpi and halteres black; the wings grayish-brown, darkest along the costal region; stigma dark brown, and the wings dark at the base, having a yellowish-red tinge when alive. The ♀ dark black; legs reddish, femora black, the tarsi dark at the tips; stalk of haltere brown. Wings brownish; the whole body clothed with short hairs. Length 2 to 3 lin.

B. clavipes, Mg. =
$$\begin{cases} Hirtea Johannis, F. \\ B. dorsalis, Mg. \\ B. flavicollis, Mg. \\ H. ephippium, Zett. \end{cases}$$

♂ black; black hairs on head and thorax, white or gray on the abdomen. Legs dark brown. The stigma is yellowish-brown. In the ♀ the pectus and abdomen are tawny beneath, the thorax generally red or reddish-brown, with two or three brown stripes. The legs are testaceous; tips of femora, tarsi and anterior tibiæ black.

There seem to be several varieties, in one the thorax has two red spots in front, in the second the red thorax has three dark stripes, in the third there are two dark brown stripes, and in another variety the thorax may be entirely red. This is an abundant species, and one subject to great variety, and may be found in woods. Length 3 to 4 lin.

B. nigriventis, Hal.

♂ black; head and thorax clothed with black hairs; abdomen with whitish hairs. Tarsi and hind tibiæ reddish-brown. In the ♀ the legs are reddish; the coxæ, trochanters, tips of tarsi and spines of the fore tibiæ black. This is not a very abundant species, it appears in the spring. Length 2 to 3 lin.

B. leucoptera, Mg.

Black with black legs. Wings of ♂ milk white, ♀ dark brownish-black, stigma and veins black in the latter. Hairs black on the head, thorax, antennæ, palpi and legs. (Sys., Beschr., i., 313, 314, 1818, Meigen).

B. ferruginatus Gmel. = *T. flavicaudis*, Deg.

Head and thorax with black hairs, body gray hairs. Tarsi reddish. Legs red in the ♀.

B. venosus, Mg. = *H. nervosa*, Mg.

Black, clothed with whitish hairs. Legs black. (B. E., iii., 138, Curtis; and Meigen, S. B., i., 3-10, 1818.)

B. reticularis, Lw.

♂ shining black with whitish hairs; anterior tibiæ with long brownish spines. ♀ blackish-brown; side of thorax tawny. Legs reddish; ends of knees and tarsi brown. Length 3 to 4 lin. (Lin. Ent., i., 380-86, 1846.)

B. varipes, Mg.

♂ black; legs black; black hairs on thorax, pale on abdomen. ♀ black; ventral surface yellowish; legs pale ferruginous; wings paler than in ♂. Length 2 $\frac{3}{4}$ to 4 lin. (L. E., i., 348.)

B. laniger, Mg. = *vernalis*, Zett., and *lanigerus*, Hoffm.

♂ black; tibiæ and tarsi ferruginous; hairs of thorax and abdomen pale. ♀ black; legs ferruginous; wings brownish; stigma pale brown. Length 2 to 3 lin. (L. E., i., 353.)

B. lacteipennis, Zett.; *B. lepidus*, Lw.; and *Anglicus*, Ver., are also found.

FAMILY SIMULIDÆ.

This family is nearly related to the *Bibionidæ*. There is only one genus in the family, and the number of species is not great. They are generally called "Sand Flies," and abound in many parts of the world, from Iceland to the tropics of Africa and America. They are particularly abundant in northern latitudes of Europe, and in North and South America, where they swarm in damp and marshy places, and are exceeding voracious; they attack human beings just as mosquitoes do, and their mouth parts being fully developed they can cause nasty wounds. Not only do they attack man and animals, but maggots and caterpillars are subject to their depredations, the females sucking out their juices with the proboscis. In England we do not suffer much from these flies, but in other parts of Europe they are very obnoxious; Schonbauer* gives an account of one, *S. columboschensis*, which is one of the greatest scourges to man and beast in the Bannat of Temeswar, in Hungary. Fries,† also, describes the molestations of these "sand flies" in Lapland. In America they are known as the "Black Fly." They are also said to live upon honey-dew. They are most restless

* Gesch. der Shadl. Kolumbaterzermucken, Wien, 1795; and Kollar's "Treatise on Injurious Insects," p. 68.

† Observ. Entom. (*Simulium*), Stockh., 1824, Fries.

insects, and even when stationary, continually move their front legs about, using them as feelers.

This family is distinguished by the following characters: (i.) the scutum of the mesothorax undivided; (ii.) the tibiæ and metatarsi broad, short and compact; (iii.) ocelli absent, which easily alone are sufficient to distinguish it from the Bibionidæ. The family has been described under the following names:

$$Simulidæ = \begin{cases} Tipulariæ latipennis, Mg. \\ Simulides, Zett. \\ Simulites, Newn. \\ Simulina, Rond. \end{cases}$$

The larvæ are aquatic and cylindrical, and live in the stems of water plants. The head is armed with the usual mouth parts and two antennæ. The larva of *S. sericeum* is slender in the middle, and lives in the stems of *Phellandrium* and of *Sium*, and has several curious appendages as described by Fries. On the head, besides the antennæ, are two peculiar hairy, flabelliform appendages, and underneath the thorax is figured a tubular process; whilst on the anal segment are several curved appendages.

The pupæ are as remarkable as the larvæ, they have on each side of the front of the sides of the thorax, eight very long filiform appendages, arising in pairs analogous to the appendages of the pupa of *Chironomus*; the posterior part of the body is enclosed in a semi-oval membranous cocoon attached to the plants and open in front. According to Audouin, it appears that the cocoon is formed entire by the larva, and afterwards eaten away as far as the thickened arch previously formed; the object of this contrivance being evidently to let the water act upon the long filaments of the pupa, which no doubt are air-tubes. The imago is hatched beneath the water, the tomentum serving to repel it. All the larvæ seem to be aquatic and to live in the stems of plants, where pupation takes place. The females are all very objectionable creatures, and follow the traveller long distances, frequently attacking him and crawling down the neck, and thus getting under the clothes. The males are harmless, and often fly in circles in the air; these "dances" are very curious to watch; they may often be seen in woods in England; when at rest, the males may be found on the leaves of trees and on flowers. Beech woods seem to be one of their favourite resorts, in June and July. According to Zetterstedt,* the common English species, *S. reptans*, is found even in the snow on the mountain sides and summits in Lapponica.

The geological range extends back to the Purbeck period, where

* Ins. Lapp., pp. 802, 144.

two species have been found in England, viz., *Simulium humidum*, Brodie, and *Simulidium priscum*, Westwood. In the tertiary rocks, Loew has recorded six species from amber, and Guérin one in Sicilian amber.

GENUS.—*Simulium* = { *Culex*, L.
Tipula, Deg.
Scatopse.
Chironomus.
Atractocera, Mg.
Simulia, Mg. and Fries.

Body small, gibbose, with a tomentum; head small; palpi 4-jointed; first joint small, second and third longer, fourth long and composed of numerous little annuli, larger in ♀ than in the ♂. Antennæ 11-jointed, narrows to the tip, a little longer than head; first and second joints remotely connected, remainder closely connected, transverse, end joint conical. Wings large, first, second and third dark, remainder of veins pale. Legs stout, compressed, unarmed; hind metatarsus incrassate in ♂, lengthened; in the ♀ hardly incrassate; ♂'s generally black, ♀ cinereous. Eyes contiguous in ♂, remote in ♀. Labrum in female lanceolate; labium linear, bidentate at tip; lingua very long, divided, apical part hairy on outer surface. Also the antennæ are more remote than in the ♂.

S. reptans, L. = { *Culex sericea*, L.
Tipula erythrocephala, Deg.
Culex reptans, Schrk.
Ragio columbatchensis, F.
S. reptans et sericea, Mg.
Atractocera argyropeza, Mg.
" *elegans*, Mg.
" *variegata*, ♀, Mg.
" *cincta*, ♂, Mg.
" *porticata*, ♀, Mg.

The male is deep black; the head is black, with the front whitish-gray. Palpi and antennæ brownish-black. Thorax with a gilded tomentum; sides white, an interrupted white band in front. Abdomen with the second and third posterior segments with silvery, often with an iridescent spot. Legs dark brownish-black. Anterior femora testaceous, anterior tibæ silvery, middle tibæ partly yellowish; posterior tibæ yellowish towards base; posterior metatarsi likewise yellowish. Halteres yellowish-brown. Wings limpid, veins near costa black, remainder light. ♀ Black also, but with a cinereous tomentum, and a white spot on each side of thorax, in front, sides of thorax silvery.

This is an abundant species, and very generally distributed, and

has been described by numerous authors under a large number of names, *some* of which I have given.

$$S. maculata, \text{Mg.} = \begin{cases} S. fuscipes, \text{Zett., Wlk., Fries.} \\ Atractocera pungens, \text{Panzer.} \\ S. marginata, \text{Mg.} \\ S. lineata, \text{Mg.} \\ S. pubiventris, \text{Zett.} \end{cases}$$

Deep black; thorax with short hairs, a cinereous tomentum over the thorax and part of abdomen. Head black, whitish underneath; antennæ and palpi brown, sometimes with a grayish tinge, also with tomentum, so also have the brown legs, which are not banded, being almost entirely brown. Halteres very dark in ♂, yellowish in ♀.



FIG. 36.—*Simulium reptans*.
A. Ungues and pulvilli of *Simulium*.
B. Ungues and pulvilli of *Dilophus*.

Literature on Bibionidæ and Simulidæ:

1. Hist. d. Ins., ii. 545, etc., 1764. Geoffroy (*Scatopse*).
2. Ento. Mag., i. 156, 1833 (*Anarete*). Haliday.
3. Illiger's Mag., ii. 264, 1803 (*Dilophus*). Meigen.
4. Lin. Ent., i. 395, etc. Loew.
5. System. Beschr., i., vi., 1830. Meigen.
6. Fauna Suec., 1768. Linné.
7. Enum. ins. austr., 877. Schranck.
8. Dip. Scand., ix., 1850. Zetterstedt.
9. Fauna. Germ., xcv. Panzer.
10. Brit. Ent., iii. Curtis.
11. Bull. sc. dép. Nord, t. i., Lille, 1878. Giard.
12. Bibioniden. aus. der Braunkohle v. Rott. Palæontogr., b. xiv., 1865. Heyden.
13. Hist. Nat. d. ins. et crust., xiv., 1804 (*Simulium*). Latreille.
14. Syst. Beschr., i., 292. Meigen.
15. Monogr. Simuliar., 1824. Fries.
16. Dip. du Nord de Fr. 1, 23. Macquart.
17. Öfv. af. k. vetensk. acad. förh., 1844, 110. Wahlberg.



FIG. 6c.



FIG. 6a.



FIG. 6b.



FIG. 7c.

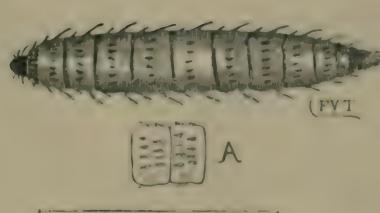


FIG. 1.



FIG. 3.



FIG. 5b.



FIG. 2.



FIG. 5a.



FIG. 5c.



FIG. 7b.



FIG. 7a.



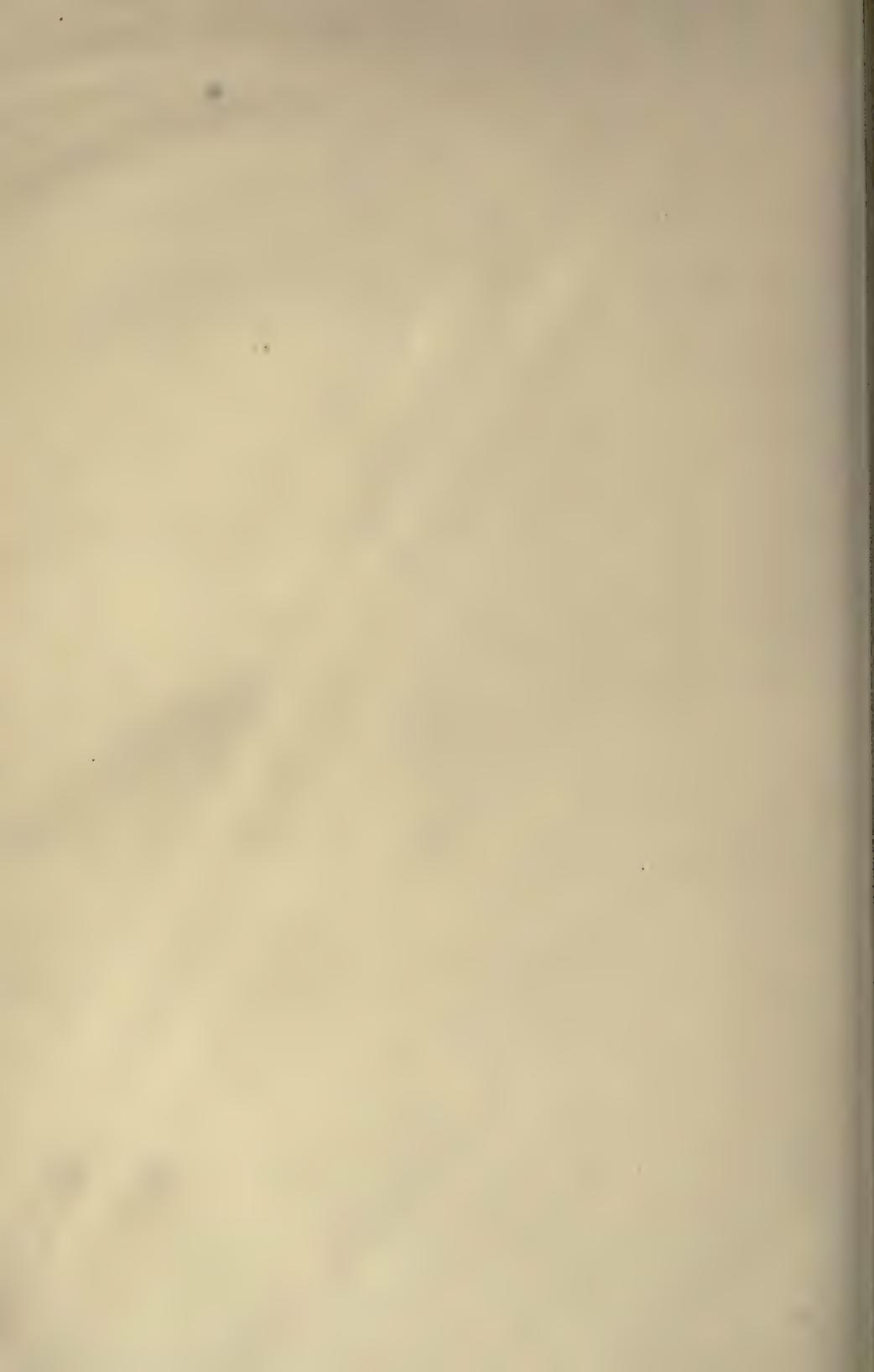
FIG. 4a.



FIG. 4b.

PLATE III.

FIG. 1.—Larva of *Bibio pomona*; A, ventral surface. FIG. 2.—Pupa of *B. pomona*. FIG. 3.—Leg of *Anarete albipennis*. FIG. 4.—Wing (A) and antenna (B) of *Scatopse bifilata*. FIG. 5.—A, Antenna of *Aspisiles berolinensis*; B, wing of ditto; C, leg of ditto. FIG. 6.—A, *Bibio marci*; B, leg of *Bibio*; C, Antenna of *B. Marci*. FIG. 7.—A, Wing of *Dilophus fibrilis*; B, leg of ditto; C, antenna of ditto.



CHAPTER VII.

THE CHIRONOMIDÆ.

THE *Chironomidæ*, or, as they are popularly called, "the Midges," are a family extremely rich in species but poor in genera. In all probability we know but a very small proportion of the species indigenous to England, although Verrall enumerates as many as 268, besides a large number of reputed ones. There seems, however, to be some doubt as to the authenticity of many of the records. Walker describes as many as 224 species of *Chironomus*, 82 of *Ceratopogon*, and 20 of other genera, 326 in all. This number has already been reduced to 268, and many of these we are not at all certain as to their true identification. The small size of many of these "midges," the difficulty of preservation and identification has hindered their study, little or nothing having been done in this country, until recently, when Mr. Verrall has worked through them.

The family *Chironomidæ* originally contained the old genera *Chironomus*, *Tanytarsus*, and *Ceratopogon* of Meigen, to which were afterwards added *Diamesa*, Mg., *Corynoneura*, Wtz., and *Clunio*, Hal., and more recently Van der Wulp has separated off the new genera *Cricotopus*, *Orthocladius*, *Camptocladius*, *Tanytarsus*, *Eurycnemus*, and *Metriocnemus*, all represented in England. The genus *Hydrobaenus* of Fries may also possibly be represented by a single species; the same may be said of Schiner's *Thalassomyia*. Not only is this family extremely rich in species, but in numbers also, many of the commoner forms appearing in immense swarms, the accounts of them that come from the tropics are marvellous.

By far the larger number appear just before sunset and shortly after, they all, and especially the more delicate coloured ones, prefer the latter part of the day for their revels in the air.

Chironomidæ may be taken anywhere, but by far the most successful hunting grounds are around pieces of water, many of the larvae being aquatic in their habits. The development of one, *C. plumosus*, has been fully dealt with by various embryologists and

entomologists, both in its pre-larval life as well as during its transformations, and we shall consider this subject more fully when dealing with their larval life.

The characters of the family are briefly as follows : Head small and often retracted under the thorax, which is without any transverse suture. Ocelli absent or rudimentary. Wings long, narrow, costal vein ending near the tip of the wing, no veins along posterior margin. Antennæ with from six to fifteen joints, which are densely pectinated in the males, but often simple in the females and smaller. Legs long and slender, tibiæ and tarsi nearly cylindrical.

The following are the synonymous names of the family :

Chironomidæ =
$$\left\{ \begin{array}{l} \text{Tipulariæ culiciformes, Mg., Macq.} \\ \text{Culicites, Newman.} \\ \text{Tipulidæ, Leach.} \\ \text{Chironomii, Zett.} \\ \text{Chironominae, Roud.} \end{array} \right.$$

The geological distribution is, strange to say, wide, we naturally should not expect to find any traces of such delicate insects as the "midge" we are considering in the rocks of any remote period, such, however, is not the case, for even in Mesozoic rocks we find representatives of these delicate flies. The Lias of Dobbertin furnishes us with a species referred to the genus *Macropeza*, and another species of the same genus has been figured by Brodie from the English Purbecks. The latter author also figures from the same horizon two possible *Chironomi*. There are also two other species possibly belonging to this family, namely, *Cecidomium grandævum*, Westwood, and *Corethrium perlina*, Westwood, from beds of Purbeckian age. But as in many other fossil insects, of which we have only fragmentary remains, there is some doubt as to their true relationship, they might possibly be intermediate types between the *Chironomidæ* and *Culicidae*. The species figured by Brodie under the name of *Rhyphus priscus* is most probably a member of this family and not of the family to which Brodie referred it.

When we reach the Tertiary beds we find a very different aspect ; as we should expect, the amber, which is such a wonderful preserver of insect life, contains many of these delicate flies, some in a beautiful state of preservation. Loew has described several species of *Tanypus* and many of *Chironomus* and *Ceratopogon*. Burmeister and Giebel also record the presence of the two latter genera in amber. Not only do we find the perfect insects but also the pupæ in a state of perfect preservation, and occasionally a maggot has been found. Besides

in the amber, we find many records in the Tertiary rocks of Aix, Rott, Radoboj, Utah, and Wyoming. They are abundant also in the Florissant beds, but, as in all other insects there, they are badly preserved. There are also records of this family from the Tertiaries of British Columbia. We thus see that during the Tertiary period the distribution of this family was, as it is now, very wide.

Geographical distribution.—The present distribution in space of at least three of the genera in the Chironomidæ is very wide, the genera *Chironomus*, *Tanypus*, and *Ceratopogon* being abundantly represented in Europe, up into the cold Northern regions and in the warmest parts alike in abundance. In America they are all abundant; whereas such genera as *Corynoneura*, *Diamesa*, etc., are scantily represented. In Africa large swarms of Chironomidæ are found over and around the lakes and lagoons, and in India and Australia they are also largely represented, especially the three genera first mentioned.

Larvæ of Chironomi.

The larvæ in this family have been very thoroughly investigated in several types, on account of their exhibiting many interesting biological features. By far the greater proportion are aquatic creatures, actively swimming about in stagnant waters, sometimes in great numbers, and, as we are told by Mr. Slater,* helping to make the water more foul, not, as is usually supposed, cleansing it. "The excreta," he says, "of the creatures contains, in fact, a powerful ferment." Not only are the aquatic forms freshwater, but marine also. Agassiz says that "The larvæ of a species of fly (*Chironomus*) is quite common off shore from our northern coasts" (America).† Another American species, *C. oceanicus*, is found at the depth of twenty fathoms. Packard also records the presence of larvæ and pupæ of Chironomi in the salt water of Clear Lake, California. I have myself taken Chironomi larvæ in pools left by the ebbing tide amongst the green algae on the Guernsey coast, but was not successful in rearing them.

Then there are saprophytic forms, those feeding upon excreta (*C. [Orthocladius] stercorarius*), and terrestrial forms living beneath the bark of trees (*Ceratopogon bipunctatus*). The larvæ are often popularly called "blood worms," on account of their bright red hue. These blood worms may nearly always be found in stagnant water, especially in butts holding rain water. One of the most abundant and typical is *Chironomus plumosus*, which we will examine in detail.

* "Entomologist," p. 89. 1879.

† "Cruises of the *Blake*," vol. i., p. 179. Harvard Bulletin, xiv., A. Agassiz.

The larvæ of Chironomus plumosus.

The body of the "blood worm" is composed of thirteen segments, it is cylindrical in shape, generally smaller at the posterior end. The head has four eyes upon it, two on each side, and a few hairs, and is armed with a pair of biting mandibles. A spinning organ is also present. The second segment is furnished on the ventral surface

FIG. 37.—Larva of *C. plumosus*.

with a pair of prolegs, the extremities of which are furnished with a number of closely set hairs, the third to tenth segments are devoid of all appendages. The eleventh and twelfth have each a pair of jointed worm-like processes. Each pair is attached to the anterior end of its segment, and wave about when the creature is swimming. The last or anal segment has a well-developed pair of prolegs which terminate in a number of claw-like portions. At the posterior extremity of the anal segment are four saccular appendages, and above these a dense tuft of hairs. Burmeister considered the prolegs branchial appendages ; they are not so, however, but are used for the same purpose as the prolegs of the caterpillar are used for. The true branchial appendages are the four egg-shaped processes on the anal segment. The larvæ grow rapidly but live some time ; they form tubes or "houses" at the bottom of the water in which they pass part of their existence. These tubes, which are tortuous, are formed out of algae (*Spirogyra*, etc.), bound together with silk from the spinning organ of the larva. They leave these burrows, according to Grumm, in the species he observed, at night ; such, however, is not the case with the blood worm, for they can be seen swimming about at any time with their curious wriggling motion.

Internal Anatomy.

Central nervous system.—This is made up of eleven ganglia united by double commissures in the middle region of the body ; some of the anterior and posterior ones lie close together.

The alimentary canal can be seen through the body-wall, and consists of the following parts: cesophagus, proventriculus, stomach, and intestine.

There is another curious larva *C. stercorarius* described by Walker,* I have not had the opportunity of examining the species myself: "The grub of *C. (Orthocladius) stercorarius* inhabits horse-dung, and has a fleshy leg on the under side of the first segment, which points towards the head, and which it has the power of lengthening and contracting. Its various serpentine contortions also assist it in moving. When removed from the substance which constitutes its food, it is enabled to regain it by leaping. Lying horizontally, it brings the anus near the head, regulating the distance by the length of the leap it means to take; when, fixing it firmly, and then suddenly resuming a rectilinear position, it is carried through the air sometimes to the distance of two or three inches. It appears to have the power of flattening the anal extremity, and even of rendering it concave, by means of which it may probably act as a sucker, and so be more firmly fixable."

From the mention of only *one* fleshy leg, I should imagine this description is taken from an immature larva. *C. plumosus* and others, when quite young, show that the *two* prolegs arise from a cleft down the centre of a single protuberance. This point is well shown in Grumm's figures of the species he made observations upon; he says: "The thorax on its ventral surface possesses a transverse fold, which is divided in the middle by a deep furrow, and transformed into a pair of clinging feet." There is little doubt that the single proleg of *stercorarius* described by Walker is accountable for in this way. The larvæ of *Tanypus* are built much upon the same type, some living in stagnant water (*T. maculatus*), others in swampy places, upon various water-weeds (*T. monilis*) almost as thin as a hair.

Pædogenesis in Chironomus.

M. Oscar v. Grumm found that agamic reproduction takes place amongst the *Chironimi*, and observed it fully in one species, and also the development from the unfecundated egg. The larvæ which this observer experimented with were clear and transparent, of a yellowish tinge, with large head, a broad thorax, and 9-jointed abdomen. The mouth armed with two pairs of strong jaws, the lower forming an immovable lip. The thoracic part on its ventral surface possessed a transverse fold, which is divided in the middle by a deep furrow; these eventually grow forward and form a pair of

* Ins. Brit., vol. iii., p. 151.

clinging feet. There are also a pair of pediform appendages figured on the last segment, analogous to those in fig. 37 of *Chironomus plumosus*, and also four branchial appendages on the same segment, with two tufts of hairs in addition. These larvae grow rapidly, so that within six or seven days they are four to five times their original length. After the third moult the larva is one third of an inch long, its head becomes smaller, and its feet elongated; the skin acquires a very delicate rose colour, caused by the development of the pupal skin beneath. The movements of the larva gradually lessen and eventually cease; it then casts its skin, and the pupal stage is reached. The pupa is three m. long, with long head, described by Grumm as not unlike that of a cat, with 9-jointed abdomen, and the six legs on the thorax, and bent around the wing cases. The abdomen is covered by many small paired hairs and longer single setæ. The sides of the abdomen exhibit long dark brown bands, which terminate in the penultimate segment in a small bunch of claw-like processes. On the last but one segment are two apertures, and between and below them a third, the anal orifice. There are also two groups of delicate hairs on the last segment. The thorax is dilated dorsally into a shield covering the head above; at the sides of the thorax the wing-cases are visible. Prominent pyriform eyes are also seen, between which lie the antennæ. Above the head are two thick filaments; these are no doubt branchiæ (resembling those seen in the pupa of *Corethra plumicornis*). No stigmata are of course seen in these aquatic forms. Such is briefly the structure of the *Chironomus* larva and pupa observed by Grumm, in which asexual reproduction was observed to take place. We remember in the case of the *Cecidomyidae*, the asexual generations were produced by the Cecid larvæ (p. 42), and that the larvæ producing the asexual generations eventually themselves turned to perfect insects. But in the case of the *Chironomidae* we find things very different; it is not the larva



FIG. 38.—Eggs of *Chironomus*.

that has the asexual reproduction, but the pupa; neither are living young (maggots or pupæ) produced but ova, whereas in *Cecidomyia* living larvæ were produced. The two holes above the anus described in the pupa are the orifices through which the eggs are

deposited. These eggs are in the form of long threads of a gelatinous nature, in which the ova are embedded in a row. Fig. 38. They are usually placed at the side of some weed or twig in the water in nature ; in confinement, at the side of the bell-glass or whatever they are contained in. The pupa on depositing a large number of eggs *generally dies*, and here again we observe a difference to *Cecidomyia*, where the maggots eventually turn to perfect flies. Occasionally the pupæ do develop, but during the summer this is only exceptional. When the autumn approaches the flies always hatch, and after copulation deposit fecundated ova in the water and die at once. Grumm notices a curious point in this ; he says that if the ova are taken from an unfecundated fly they develop just the same during the autumn, only development is of longer duration.

Pupa of Chironomi.

In many respects the pupæ of these midges resemble those of gnats. They are naked, no puparium or case of any kind being present. They remain at the bottom of the water until near the time for the emergence of the perfect insect, when by various movements they approach the surface. The power of swimming seems to be present in all the aquatic forms. Two things are necessary for



FIG. 39.—Pupa of *Chironomus plumosus*.

the extrication of the imago, first, that the thorax, which is always placed upwards, should be slightly above the surface of the water ; and, secondly, that the chrysalis is level with the surface. The imago escapes by the splitting of the upper region of the thorax, which has a curious power of repelling water. The insect on coming out of the orifice formed in the thorax, places its legs on the water, and by degrees draws itself completely out of its shell, the case forming a boat, much in the same way as seen in the gnat. On each side of the thorax is a bunch of hairs (five in *C. plumosus*), which form a star when expanded ; the anus is also provided with a fan-

shaped bunch of hairs. The body is composed of eight segments. The pupæ are often bent (*Tanypus*) like those of *Culex*. Two curious respiratory appendages are also present on the back of the pupæ of this genus; it appears that these two external pupal appendages arise from the two internal ones seen in the larvæ. The pupæ are always active creatures, even the terrestrial ones moving about violently if disturbed.

GENUS.—*Corynoneura*, Wtz. = *Chironomus*, Mg., Zett.

The members of this genus are very minute, the largest European species being only $\frac{5}{12}$ of a line long, and with alar expansion often not more than $\frac{1}{2}$ lin. The body is elongated and head nearly round; the proboscis is very short; the palpi, which are 4-jointed, are curved downwards, the fourth joint being nearly as long as the other three. The antennæ are filiform, and arise from a thickened basal joint, the last joint is usually larger than the intermediate ones; 10-jointed in ♂, 6-jointed in ♀; the hairs on the ♂ antenna long, with a bunch of star-like hairs on the distal joint. Scutellum is small. Metathorax elevated. Wings bare; costa clavate and very short. Abdomen composed of eight segments. Hind tibiæ have a long spur on the upper side and two spines beneath. Plate iv., fig. 1.

They may be found in abundance near water, and have a curious habit of running about on stones, etc., in circles and curves with astonishing rapidity. I have noticed them to be more abundant near rapid and rocky streams, such as we find in mountainous tracts.

C. minuta, Wtz. = *C. minutissima*, Mg., *C. celeripes*, Wtz.

This is a common species around lakes, and especially along the banks of rapid streams. It appears about May, and lasts on until the autumn. The head and thorax are black in the ♂. Proboscis, palpi and antennæ are whitish, the basal joints of antennæ brown. The abdomen is greenish-white, the last segments (1-3) brown. Legs brown, femora white, with dusky tips. In the ♀ the head is also black, but the thorax is yellow; the mesonotum has three broad black stripes, almost covering the whole thorax. Scutellum black, and also the metanotum. The pectus is dark brown. Abdomen black, with pale bands, pale brown on the ventral surface. Legs lighter than in ♂; the wings are white, not yellow, as in the ♂. Length, $\frac{5}{12}$ lin. Taken in Wales, Devonshire and Monmouthshire.

C. atomaria, Zett.

This species is recorded by Walker, but its identification seems uncertain. It is black (δ), yellow in the female, with *brown scutellum with a yellow base*. The wings of the δ white, not yellow, as in *minuta*; the wings of the φ are, however, yellow, contrary to *minuta*.

GENUS.—*Chironomus*.

The members of this large genus, which possibly contains more than one hundred British species, are mostly small flies; *plumosus*, one of the largest, seldom exceeding 6 lin. in length. The eyes are reniform and separate in both male and female. The palpi, which are 4-jointed, are usually curved and pubescent; the first joint is small, the second and third of moderate length and nearly equal, the fourth is longer and more slender. Antennæ plumose and seated in a notch in the eye. Wings elongated, generally bare, narrow; a deep notch on the posterior margin at the base of the wing. Abdomen is composed of eight segments, slender, sometimes flattened dorso-ventrally. Legs long and slender, no spurs or spines, sometimes slightly hairy; unguis or claws and onychia very small. In the male the antennæ are 13-jointed, densely plumose, the hairs gradually decreasing towards the tip of the antenna; the first joint is short and cylindrical, the next eleven joints are also very short, the thirteenth being filiform, and as long as all the others put together. There are four apical appendages in the male, which are often hairy. In the female the antennæ are only 6-jointed, not more than half the length of the thorax, hairs few and not nearly so long as in the male. Abdomen shorter and thicker than in the male. The pectoral arolet is not closed in this genus, as in *Tanypus*. Pl. iv., figs. 2, 3, etc.

Chironomus plumosus, L. = $\left\{ \begin{array}{l} C. annularis, \text{Lat.} \\ C. grandis, \text{Mg.} \end{array} \right.$

This is one of the largest European chironomi, sometimes measuring as much as 6 lin. in length; it is a very abundant species in most parts of England, and appears from spring to autumn.

The body of this species, which is testaceous in colour, is covered with a silvery-gray tomentum. The thorax is marked with three dark gray or brown stripes; head testaceous, antennæ and palpi also dark brown to testaceous. Abdomen gray, sometimes brownish-gray, the hind borders of the segments pale gray, hairy. Wings have a distinct black dot upon their discal area; the costal is dark brown,

also the first and second longitudinals, the remaining veins pale and indistinct. The legs are testaceous, the apices of the tibiæ and tarsi dark brown, minutely hairy. Pl. iv., fig. 5.

Antennæ in female 6-jointed, the sixth joint being long and pointed, hairy; the other joints verticillate, pilose; in the male the antennæ are plumose, and the whole body and legs more hairy.

C. riparius, Mg. = *C. zonulus*, Zett.

This is a black and green species, widely distributed. The ground colour of both male and female is almost black. The thorax is green, with three dark brown or black stripes; there is also a green band on the hind border of each abdominal segment. The wings are milky; the costal, first and second veins are light brown, the discal transverse veinlet deep black, the remaining veins pale. Legs green, except at the posterior ends of the tibiæ and the tarsal joints. Length, 3 to $3\frac{1}{2}$ lin.

C. pallens, Mg.

This species resembles *riparius*, but the legs are *testaceous*, and the thorax of the male is hoary. A common species.

C. tendens, F.

This is a testaceous species, with black head and palpi. Veins of the wings white, except along the costa, where a faint reddish-brown tinge may be observed. The legs are long and slender, and rather paler than the body. The posterior borders of the abdominal segments are also paler than the general body colour. Length, $3\frac{1}{2}$ to 4 lin. Common.

C. annularis, Deg. = $\begin{cases} C. pallens, Mg. \\ C. annularius, Lat. \end{cases}$

A widely distributed and common species, gray; thorax with three black stripes; abdomen almost black, with a gray band on the hind border of each segment, the whole body hairy. Palpi and antennæ black; the wings are hairy on the hind border, the costal is black, as also are the first and second longitudinals and the discal transverse veinlet; the remaining veins are pale. Legs testaceous, coxæ gray, tips of tibiæ and tarsi black. Length, $3\frac{1}{2}$ to 4 lin.

C. virescens, Mg. = *Tipula virginea*, Schrk.

Green; thorax green with three pale reddish stripes; antennæ testaceous. Legs pale green. Wings with upper veins testaceous. Length, 1 lin.

C. prasinatus, Staeg.

Green; thorax with three black stripes. Legs pale and testaceous; antennæ brown in ♂; head black; halteres white; wings having upper veins testaceous, rest white. Length, 1 to 1½ lin.

C. tentans, F. = *C. vernalis*, Mg.

Green; the thorax having three black stripes; the abdomen green with black bands, which often reach the posterior borders of the segments, only a small spot of green being seen on each side. Legs pale green, tips of tibiæ and tarsi black. Wings with testaceous upper veins and black discal transverse veinlet. Antennæ brown in ♂; testaceous in ♀, occasionally black at the tip. A large species, often reaching 4 lin. in length.

C. dorsalis, Mg.

A pale green species. Thorax with three luteous stripes; metathorax brown. Abdomen with brown bands, green on the hind borders of the segments. Legs slender, pale green, tips of tibiæ, tarsi and femora dark. Wings have the veins near the costa, testaceous, also the discal transverse veinlet. Length, 3½ to 4 lin.

C. rufipes, L. = *C. pulcher*, Zett., *bifasciatus*, Mg.

Black and shiny, more heavily built than most Chironomi. Abdomen hairy, with a reddish band on each segment. Wings with a broad brown band a little before the centre. The costal, first and second longitudinal veins testaceous, remainder white. Legs stout, hairy, testaceous; tips of joints dark. Length, 3 to 3½ lin.

C. chloris, Mg.

Dark greenish-black; head black, thorax with three black stripes, breast hoary; abdomen olive green, darker towards the anterior borders. Legs testaceous, joints with black tips. Length, 2 to 2½ lin.

C. dispar, Mg. = *C. lucidus*, Zett.

Shining black; abdomen brownish, with very shiny hairs and sometimes a reddish-yellow marking at the side; anal segment smaller and shorter than the preceding; head black. Legs testaceous, long and slender, femora brown, also tips of tibiæ and tarsi. Antennæ brown in ♂, yellow in ♀. Length, 3 lin.

C. pedellus, Drg. = *Tipula littoralis*, L., *T. cantans*, F.

Shining black; abdomen bright green, black at the tip and

clothed with white downy hairs ; head and palpi brownish. Antennæ in ♂ brown, almost white at the tips ; in ♀ they are yellow, and the thorax is yellowish-green, with three dark stripes. Legs pale green, tips of all the joints black. Wings pale. Length, 3 to $3\frac{1}{2}$ lin.

C. pedestris, Mg.

Wings pale, the extremity black. Closely related to the former.

C. pictulus, Mg. = *C. stricticus*, F., *C. histrio*, Zett.

Black. Wings white, with a dark discal spot and with three pale gray spots in the disc of the areolets, two along hind border and one towards the tip ; anterior veins testaceous, rest pale. Thorax grayish, with three black stripes. Abdomen with a pale band on hind border of each segment. Legs almost white, hairy, tips of joints dark brown. Length, 3 to $3\frac{1}{2}$ lin. A large and common species.

C. albimanus, Mg. = *C. annularis*, Mg., Panzer.

Shining black ; legs long and slender, dark brown, *metatarsi white*, also posterior tibiæ. Anterior veins of wings *black*, rest white. Length, 2 to 3 lin.

C. aprilinus, Mg.

Yellowish-green ; thorax with three dark brown stripes, sides of thorax testaceous, with gray hairs. Abdomen black, with a band of gray hairs on the posterior border of each segment, anal segment black. Head dark brown. Legs testaceous, tips of the joints brown. Wings whitish, costal and two front veins and discal transverse veinlet brown. Length, $2\frac{1}{2}$ to 3 lin.

C. nubeculosus, Mg.

Testaceous ; head dark brown, palpi and antennæ black. Thorax with three dark stripes. Abdomen black, the hind border of each segment being silvery white. Wings whitish, with gray stripes along the veins, veins all pale. Legs reddish-brown, long and slender. Length, $2\frac{1}{2}$ to 3 lin. Not uncommon near most damp places.

C. maculipennis, Mg.

Black ; thorax gray above, with four slender deep-brown stripes. Abdomen very hairy. Wings white, with gray oblong spots on the discs of most of the areolets, veins all pale, the 1st, 2nd and 3rd sometimes faint brown. Legs dull reddish-brown, coxae and femora black, long and slender. Length, $2\frac{1}{2}$ to 3 lin. Common, but somewhat local.

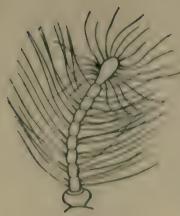


FIG. 1B.

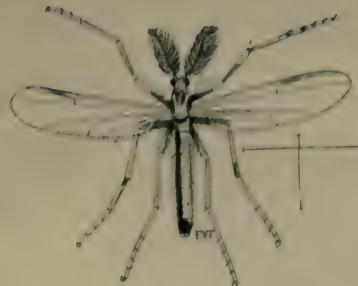


FIG. 5.



FIG. 6B.



FIG. 1A.

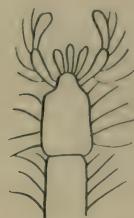


FIG. 3.



FIG. 7.

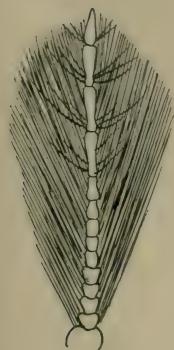


FIG. 10.

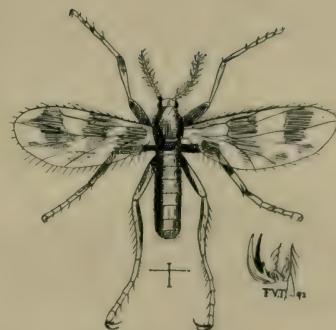


FIG. 8.

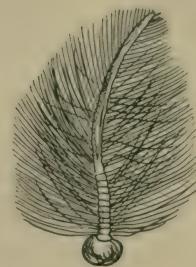


FIG. 9.

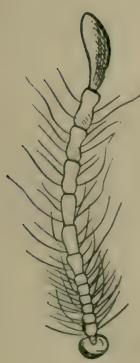


FIG. 4.

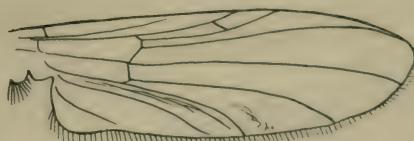


FIG. 6A.

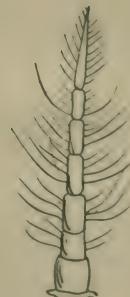


FIG. 2.

GENUS.—*Cricotopus*, V. d. Wulp.

Wings naked; feet marked with white and black bands; first joint of fore tarsi considerably shorter than the tibiæ; anal ring in ♂ shorter than the preceding segments and broader than long; the pincers short and thick, snow-white. The species are all small (1 to 2 lin.), and generally yellow and black. Three shining black streaks on the thorax, in some so broad that only two spots on the shoulders remain.

C. tibialis, Mg.

Shining black; abdomen with a pale band on each segment, paler than thorax; antennæ brown; legs dark brown, with a white band on each tibia; anterior tarsi bare; metatarsus almost twice as short as the tibiæ. Wings milk-white, with pale veins. Length, 1 to 2 lin. Rare.

C. motitator, L. = *Tipula motitatrix*, L., and *C. dizonias*, Mg.

Yellow, shining; thorax with three black stripes. Abdomen black, with two yellow bands near the base and one in the middle; sometimes these bands are reduced to spots. Antennæ and palpi brownish. Legs white; femora and tips and bases of tibiæ black or brown; anterior tarsi black, middle tarsi, with sometimes the third hind tarsi, with fourth joint white. Wings white, costal and first and second veins dark, rest pale. Length, 1 to 1½ lin. A common and generally distributed species; amongst grass and rough herbage.

C. annulipes, Mg.

Black; thorax with a yellow border in front, pectus black, also metathorax and scutellum; hind borders of abdominal segments yellow; legs black, femora yellowish-white towards the base, a yellowish-white band also present on the tibiæ. The ♀ is yellow, thorax with three black stripes, rest of thoracic region black. Wings grayish. Length, 1½ to 1¾ lin.

C. tremulus, L.

Yellow, shiny. Thorax with three black stripes. Abdomen black, yellowish at the base in the ♀; in the ♂ the segments are pale brown or white at the edge. Legs black, tibiæ white except at the ends. A common species, and generally distributed. Length, 1 to 1½ lin.

The following are also described by Walker:

C. sylvestris, F. = *C. vibra* ♂ *torius*, Mg. ♂ Shining yellow, with three broad black bands on the thorax. Legs white. Abdomen yellow with black bands. Length, 1½ lin.

<i>C. inscendens</i> , Wlk. ...	...	Black, stout. Legs long; posterior tibiae whitish-black at base and at tips. Length, $2\frac{1}{2}$ lin.
<i>C. venosus</i> , Mg. ...	...	Black. Thorax reddish on the sides, and with three slender red stripes. Abdomen with a tawny band on posterior edge of each segment, and covered with white down. Legs testaceous. Length, 3 lin.
<i>C. rubicundus</i> , Mg. ...	...	Pale testaceous. Thorax with three gray stripes. Abdomen reddish-brown. Legs testaceous, tips of joints dark. Length, 1 lin.
<i>C. minusculus</i> , Wlk. ...	...	Pale green. Thorax with three luteous stripes. Legs as in <i>rubicundus</i> (♀).
<i>C. nigratus</i> , Wlk. ...	...	Black. Legs testaceous. Smaller than <i>venosus</i> . Length, 1 lin. (♀).
<i>C. nexilis</i> , Wlk. ...	...	Hoary. Thorax with three blackish stripes. Abdomen piceous. Legs long and slender, testaceous, joints dark. Length, $2\frac{1}{2}$ lin. (♂).
<i>C. inserpens</i> , Wlk. ...	...	Testaceous, green. Thorax with three brown stripes. Legs as above. Length, 2 to $2\frac{1}{2}$ lin.
<i>C. plebeius</i> , Mg. ...	...	Black. Legs pale brown, joints dark; fore metatarsi whitish except at the tips. Length, 2 lin.

GENUS.—*Orthocladius*, V. d. Wulp.

Wings naked; cubital vein straight, simple, bent upwards a little, reaching to the end of the costal; under prong of the postical fork straight or bending slightly. Tarsi hairy, the joints darkened; first joint of the anterior tarsi considerably shorter than the tibiae. ♂ genitalia slender.

O. dolens, Wlk.

“♂ black. Abdomen long, very hairy; antennæ with black plumes. Wings whitish; costal, cubital and radial veins testaceous, the rest whitish; distal transverse veinlet dark brown. Halteres brown. Legs brown, long, slender, slightly hairy; fore tibiae and fore tarsi very hairy. Length, 4 lin.” Described by Walker.

O. stercorarius, Dg. = *C. chiopterus*, Mg.

Black. Abdomen pubescent. Legs piceous, minutely pubescent. Wings pale in ♂, darker in the ♀; the body is also shiny in the latter. Antennæ black. The larvæ which live in dung are described on p. 173.

There are a large number of species of this genus named in Verrall's list, but as they are all given in italics, they are only described here briefly.

<i>O. mærens</i> , Wlk.	Black, very stout and hairy. Wings dark at base. Legs ferruginous and very hairy. Length, 4 lin. (♂).
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<i>O. irritus</i> , Wlk.	Black. Legs brown, slender. Length, $1\frac{1}{2}$ lin. (δ).
<i>O. variabilis</i> , Staeg.	Black. Thorax dingy, testaceous, with three broad, almost confluent, black stripes. Abdomen brownish-black, not pubescent. Legs brown, tarsi black. Length, 2 to $2\frac{1}{2}$ lin.
<i>O. intrudens</i> , Wlk. ...	...	Black. Thorax tawny, with three black stripes. Halteres testaceous. Legs ferruginous; tarsi and fore tibiae blackish. Length, 3 to $3\frac{1}{2}$ lin.
<i>O. pervulsus</i> , Wlk. ...	...	Black, stout. Wings black at base; halteres white. Legs dark brown, stout. Length, $1\frac{1}{2}$ to 2 lin. (δ).
<i>O. excerptus</i> , Wlk. ...	...	Black. Legs black, femora piceous, testaceous at base. First, second and third veins brown. Length, $1\frac{1}{2}$ lin. (δ).
<i>O. nactus</i> , Wlk. ...	...	Black. Legs blackish, slender. Veins white. Abdomen long and slender. Length $1\frac{1}{2}$ to 2 lin.
<i>O. oblidens</i> , Wlk. ...	...	Deep black. Legs long and slender. First, second and third veins brown. Length, $2\frac{1}{2}$ lin. (δ).
<i>O. effusus</i> , Wlk. ...	...	Black. Abdomen dark brown. First, second and third veins pale testaceous. Legs hairy, dull testaceous. Length, 1 to $1\frac{1}{2}$ lin.
<i>O. incomptus</i> , Wlk. ...	...	Black, stout. Thorax tawny above, with three broad black stripes. Abdomen hairy, gray posterior edge to each segment. Veins blackish. Legs tawny, stout; tarsi black. Length, $2\frac{1}{2}$ lin. (δ).
<i>O. persidens</i> , Wlk. ...	...	Black. Thorax dingy testaceous, with three broad black stripes. Wings clouded with black at base; first, second and third veins testaceous. Abdomen pubescent. Legs brown, slender. Length, 2 lin. (δ).
<i>O. obditus</i> , Wlk. ...	...	Testaceous, stout; three black stripes on thorax. Metathorax and pectus black. Abdomen brown, shining, pubescent. Legs ferruginous, slender; tarsi and fore tibiae dark brown. Length, 2 to 3 lin.
<i>O. olivaceus</i> , Wlk. ...	...	Dull tawny green. Three black stripes on thorax. Pectus and metathorax black. Abdomen brownish. Legs tawny; tarsi and fore tibiae brown. Length, $2\frac{1}{2}$ lin.
<i>O. testaceus</i> , Macq. ...	...	Testaceous, stout. Thorax striped (δ), brown in δ , pale tawny in φ . Metathorax brown in δ , tawny in φ . Abdomen brown, hairy, testaceous at tip in δ , all testaceous in φ . Length, $1\frac{1}{2}$ to $1\frac{3}{4}$ lin.
<i>O. expatiens</i> , Wlk. ...	...	Testaceous. Thorax with three luteous stripes; metathorax brown. Brown bands on abdominal segment in front. Legs stout, marked with brown. Length, $1\frac{1}{2}$ lin. (φ).
<i>O. pertenuis</i> , Wlk. ...	...	Pale testaceous, slender. Thorax slightly produced in front. Legs slender. Length, 1 lin. (φ).
<i>O. barbicornis</i> , F. = <i>C. obscurus</i> , Mg. ...	...	Deep black. Wings milky white. Legs black, femora hairy, stout. Length, $1\frac{1}{2}$ to 2 lin.
<i>O. permacer</i> , Wlk. ...	...	Black, slender. Pectus and abdomen beneath gray. Legs long and slender; hind metatarsus more than two-thirds of length of hind tibia. Length, 2 lin.

<i>O. incallidus</i> , Wlk. ...	...	Legs stouter than <i>permacer</i> , and hind metatarsus is less than two-thirds of the length of the hind tibia (nearly allied to former). Length, $2\frac{1}{4}$ lin. (♂).
<i>O. obsepiens</i> , Wlk. ...	...	Black. Abdomen greenish-black. Legs dingy whitish, slender. Length, $1\frac{1}{2}$ lin.
<i>O. paganicus</i> , Wlk. ...	...	Grayish-black. Legs piceous, slender. Length, $1\frac{1}{2}$ lin. (♀).
<i>O. oppertus</i> , Wlk. ...	...	Black, stout. Thorax shining. Abdomen pubescent. Legs stout. Length, $2\frac{1}{2}$ lin. (♂).
<i>O. novatus</i> , Wlk. ...	...	Cinereous-black. Legs dark brown, slender. Length, $1\frac{1}{2}$ to 2 lin. Common.
<i>O. effectus</i> , Wlk. ...	...	Black, slender. Thorax hoary, with three black almost confluent stripes. Abdomen piceous, black. Legs brown, long and slender. Length, $2\frac{1}{2}$ lin. (♂).
<i>O. sordidellus</i> , Zett. ...	...	Testaceous. Thorax with three black stripes; metathorax black. Abdomen brown, first, second and third veins testaceous; discal transverse veinlet brown. Legs dull and testaceous, long; tips of tibiae and tarsi black. Length, 3 lin.
<i>O. frigidus</i> , Zett. ...	...	Black. Thorax testaceous, with three broad black stripes. Legs brown. Length, 1 lin. (♂).
<i>O. notatus</i> , Mg. ...	...	Testaceous. Thorax with three black stripes; metathorax black. Abdomen pale brown. Legs testaceous, slender; tarsi and tips of tibiae brown. Length, $1\frac{1}{4}$ lin. (♀).
<i>O. lucens</i> , Zett. ...	...	Black, stout and pubescent. Legs piceous, pubescent, stout. Wings blackish at the base; veins white. Halteres brown. Length, 3 lin. (♂).
<i>O. minutus</i> , Zett. ...	...	Black. First, second and third veins testaceous, Halteres white. Legs dull, testaceous, tarsi brownish. Length, $\frac{3}{4}$ lin. (♀).
<i>O. opprens</i> , Wlk. ...	...	Black. Thorax shiny. Legs black, long and slender. Halteres white. Veins as above. Length, $1\frac{1}{2}$ to 2 lin. (♂).
<i>O. nitidicollis</i> , Steph. ...	...	Black. Thorax shiny. Veins white. Halteres brown. Legs ferruginous, pubescent. Length, 2 lin. (♂).
<i>O. pergens</i> , Wlk. ...	...	Hoary. Thorax with three black stripes; abdomen black, cinereous beneath. Legs tawny, long and slender. Length, $2\frac{1}{2}$ lin. (♂).
<i>O. deproperans</i> , Wlk. ...	...	Black. Thorax as above. First, second and third veins dark brown, rest pale brown. Yellow band on hind border of each abdominal segment. Legs black, stout. Length, $1\frac{1}{2}$ lin. (♀).
<i>O. obsistens</i> (♂), Wlk. ...	...	Black. First, second, and third veins black, rest brown. Probably the ♂ of <i>deproperans</i> (F.V.T.).
<i>O. pertractus</i> , Wlk. ...	...	Hoary, slender. Thorax as above. Veins white. Abdomen cinereous-black; sutures whitish. Legs piceous, rather long and slender. Length, $2\frac{1}{2}$ lin. (♂).
<i>O. moturus</i> , Wlk. ...	...	Gray. Abdomen black, hind borders of the segments gray. Legs black, femora thick. Length, $1\frac{3}{4}$ lin.

<i>O. denotatus</i> , Wlk. ...	...	Testaceous. Thorax with three brown stripes ; metathorax black. Veins white. Abdomen brown, testaceous beneath towards the base. Legs pale testaceous. Length, $2\frac{1}{2}$ lin.
<i>O. melaleucus</i> , Mg. ...	...	(Var. ? ♀.) Whitish. Thorax as above. First, second and third veins brown. Abdomen and legs brown. Length, $1\frac{1}{2}$ lin.
<i>O. alligatus</i> , Wlk. ...	...	Black. Wings whitish. First, second, and third and discal transverse veinlet brown. Length, 2 lin. (♂).
<i>O. adjunctus</i> , Wlk. ...	...	Hoary. Wings brownish along the costa. Abdomen brown, livid beneath. Legs blackish-brown, long ; femora thick. Length, $1\frac{3}{4}$ lin. (♀).
<i>O. coquatus</i> , Wlk. ...	...	Black, shining. Legs brown. Length $1\frac{1}{2}$ lin. (♀).
<i>O. appositus</i> , Wlk. ...	...	Black. Abdomen blackish-brown. Legs dark brown, pubescent, long and slender. Length, $2\frac{1}{2}$ lin. (♂).
<i>O. peregrinus</i> , Wlk. ...	...	Pale testaceous. Veins and halteres white. Legs short and stout. Length, $\frac{3}{2}$ lin. (♀).
<i>O. compactus</i> , Wlk. ...	...	Black. First, second, and third veins testaceous. Halteres blackish. Legs ferruginous ; tarsi black. Length, $1\frac{1}{2}$ lin. (♀).
<i>O. contingens</i> , Wlk. ...	...	Black. Wings as above. Halteres whitish. Legs brown. Abdomen pubescent. Length, $1\frac{1}{2}$ lin. (♂).
<i>O. fertus</i> , Wlk. ...	...	Black. Thorax gray with three black stripes. First, second, and third veins black, rest brown. Halteres white. Legs stout, pubescent. Length, 2 lin.
<i>O. habilis</i> , Wlk. ...	...	Black. Halteres white with black tips. Legs whitish, slender. Length, 1 lin. (♀).
<i>O. pygmaeus</i> , Mg. ...	...	(Var. ? ♀) Testaceous. Thorax with three brown stripes. First, second, and third veins brown, rest white. Abdomen with black dorsal stripe. Legs dull, testaceous. Length, $\frac{3}{4}$ lin.

GENUS.—*Camptocladius*, V. d. Wulp.

Wings naked ; cubital vein bends upwards, and ends considerably before the end of the costal ; lower prong of the postical fork curved in an S-shape. Joints of the feet hairy, generally black ; first joint of anterior tarsi considerably shorter than tibiæ, anal ring in ♂ short and broad ; the forceps thick, white, with white hairs.

C. byssinus, Schrk.

Dull black ; legs somewhat paler ; blackish-brown, stout ; plumes of the antennæ brownish-black, whitish towards the tips ; wings milk-white ; halteres black ; abdomen slightly pubescent. Length, $\frac{3}{4}$ to $1\frac{1}{2}$ lin.

C. aterrimus, Mg.

Deep black. Halteres black. Wings with black upper veins, rest pale. Abdomen and legs very hairy ; femora stout. Larger than the above ($1\frac{1}{2}$ to 2 lin.). Common.

C. minimus, Mg.

Deep black. Veins of wings all white; halteres white. Legs slightly pubescent, and deep shiny black. Length, $\frac{1}{2}$ to $\frac{3}{4}$ lin.

GENUS.—*Tanytarsus*, V. d. Wulp.

Wings hairy; cubital vein straight, or almost straight, ending near the end of costal; first joint of the anterior tarsi *longer* than the tibiæ. Forceps of ♂ slender.

T. punctipes, Wied.

Black, with green abdomen. Wings milk-white, with pale veins. Legs reddish-brown, often very pale and transparent. Antennæ brown; halteres green. Length, $1\frac{1}{2}$ to 2 lin. An abundant autumnal species.

T. tenuis, Mg.

Thorax green, with three dark gray stripes; rest dark brown to black. Veins of the wings testaceous. Halteres white. Legs and antennæ and head tawny. Length, $1\frac{1}{2}$ to 2 lin.

T. flavipes, Mg.

Shining black; head and antennæ dark brown. Wings whitish. Veins pale, reddish-brown towards the costa. Halteres white, with black knob. Anterior legs tawny, and dark brown towards the apex of joints; mesothoracic legs the same; metathoracic pair black; femora partly tawny. Length, $1\frac{1}{2}$ to 2 lin. A fairly abundant species in summer and autumn.

The following are also probably British:

<i>T. ictericus</i> , Wlk. ...	... { Testaceous. Wings pubescent, nearly limpid; veins and halteres whitish. Legs pale testaceous. Length, 1 lin. (♀).
<i>T. flabellatus</i> , Mg. ...	... { Brownish-black. Thorax testaceous, with three black stripes. First, second, and third veins brown, rest testaceous. Legs dark testaceous. Length, 2 lin.
<i>T. pusio</i> , Mg. ...	... { Dark green. Thorax with three black stripes. Legs pale dull testaceous green. Length, $1\frac{3}{4}$ lin. (♂)
<i>T. præcox</i> , Mg. ...	... { Black. Thorax gray, with three black dorsal stripes. Wings pubescent; first, second, and third veins testaceous. Abdomen pubescent. Legs brown, long, slender, minutely pubescent; tarsi and tips of femora and tibiæ black. Common. Appears in April. Length, 3 lin.
<i>T. debilis</i> , Mg. (?) ...	... { Testaceous. Thorax with three brown stripes. Wings pubescent; veins brown. Abdomen green, hind borders of segments brown towards the tip. Length, 2 lin.

<i>T. vernus</i> , Mg. (?)	...	Black. Lower veins white. Abdomen dark brown, pubescent. Legs dingy testaceous, very pubescent, long and slender; tips of tibiae and tarsi black. Length, 2 lin.
<i>T. parilis</i> , Wlk.	...	Green. Three testaceous stripes on thorax. Wings pubescent; first, second, and third veins testaceous. Legs pale green; tips of tibiae and tarsi and whole of fore tarsi blackish. (Var. β . Pale green. Stripes of thorax almost obsolete.) Common. Length, 2 to 3 lin.
<i>T. affinis</i> , Wlk.	...	Pale luteous. Wings pubescent; veins testaceous. Abdomen pale green. Legs testaceous, long and slender. Abdomen luteous towards the tip in the δ . Length, 1 $\frac{1}{2}$ to 1 $\frac{3}{4}$ lin.
<i>T. patens</i> , Wlk.	...	Piceous. Thorax shining. Abdomen brown; hind borders of the segments and under side whitish. Legs testaceous, long and slender; fore femora slightly brownish towards the tip. Length, 3 lin.
<i>T. cingulatus</i> , Wlk.	...	Testaceous. Thorax with three pale brown stripes. Abdomen brown, very pilose, with a whitish band on each segment. Legs testaceous, pubescent. Length, 2 lin.

GENUS.—*Eurycnemus*, V. d. Wulp.

Wings hairy; cubital vein ending near end of costal; lower prong of postical fork curved near base. Thorax elevated. Tarsi stout; posterior tibiae thick, broad, and hairy; first joint of anterior tarsi shorter than the tibiae.

$$E. elegans, \text{Mg.} = \begin{cases} C. Crassepes, \text{Panz.} \\ C. aestivus, \text{Curtis.} \\ C. hirtipes, \text{Mcq.} \end{cases}$$

This is the only species of this genus found in England, and is abundant at times in woods, but appears to be very local. It is testaceous in colour; the thorax is elevated, and has three dark stripes upon it, with a row of black spots on each side; the abdomen is covered with black dots, which are really small punctures. The head is dark brown. Wings clear, testaceous along the costa, and marked with three black spots; one near the hind border, and the other two towards the centre, at about two-thirds of the length of the wing. Halteres pale yellow, almost white. Legs thick and pubescent. Length, 3 to 3 $\frac{1}{2}$ lin.

GENUS.—*Metriocnemus*, V. d. Wulp.

Wings hairy; cubital ending near end of costal. Thorax not ending in a point. Tarsi slender; tibiae moderate in breadth. First joint of the anterior tarsi shorter than the tibiae. Pl. iv., fig. 9.

M. fuscipes, Mg.

Black, rather shiny; anal segment broader than the preceding ones; the male forceps small, thick. Palpi and antennæ black. Legs black to reddish-brown. Metatarsus of the anterior legs shorter than the tibiæ. Wings slightly brownish-gray, pubescent, hairs dark. Length, $1\frac{1}{2}$ to 2 lin.

M. expalpans, Wlk.

Very pale brown, almost white. Head, palpi, and antennæ blackish-brown. Thorax with three dark brown stripes. Abdomen with a brown band on each segment at the anterior edge. Wings gray, pubescent; veins testaceous. Legs pale testaceous, pubescent, long; tips of the joints dark. Length, 2 to $2\frac{1}{2}$ lin.

M. nugax, Wlk.

"Fawn-colour. Wings limpid, pubescent; transverse veinlet black; costal, radial, and cubital veins pale testaceous, rest white. Halteres white. Abdomen whitish, pubescent; sutures of segments brown. Legs whitish, pubescent. Length, $2\frac{1}{2}$ lin." (Walker). Rare.

The following are also described:

<i>M. interseptus</i> , Wlk.	...	Whitish testaceous. Thorax with three reddish confluent stripes. Metathorax reddish. Legs pale testaceous. Length, 2 lin. (♀).
<i>M. impensus</i> , Wlk. (?)	...	Black. Abdomen reddish. Legs testaceous, short and stout. Length, $\frac{3}{4}$ lin. (♀).
<i>M. modestus</i> , Mg. (?)	...	Pale testaceous. Thorax with three black stripes. Veins all white. Abdomen brown. Tarsi and tips of joints of legs brown. Length, 1 lin. (♂).
<i>M. divisus</i> , Wlk.	...	Pale testaceous. Thorax with three reddish stripes. Abdomen with two brown bands before the middle and the three apical segments black. Legs whitish. Length, 2 lin.
<i>M. lacustris</i> , Hal.	...	Light grass-green. Three ferruginous stripes on thorax; dusky at the tip. Wings naked; veins yellowish. Antennæ 12-jointed in ♂, yellow; 7-jointed in ♀, last joint dusky. Length, 2 lin. (♂), $1\frac{1}{2}$ lin. (♀). Found by Haliday by Loch Fad (Bute), Lough Neagh, and Lough Derg.

GENUS.—*Diamesa*, Mg. = *Chironomus*, Wlk. pt.

Antennæ of the ♀ 7-jointed, the joints round, the last joint cylindrical. Antennæ of ♂ plumose in all but *tonsus*. Eyes oval and on the side of the head. The form of the eyes and veins of the wings resemble *Tanypterus*. There is a closed basal areolet (pobrachial) as in *Tanypterus*. But in *Tanypterus* the ♂ and ♀ have 15-jointed antennæ. The fourth tarsal joint is notched at the tip. Pl. iv., fig. 4.

D. obscurimanus, Mg.

Testaceous, shiny. Head black; thorax with three black stripes. The abdomen is black, the posterior borders of the segments being testaceous. The antennæ are black and composed of seven joints, paler at the base; in the ♂ the plumose antennæ have the last joint very long. Wings have the costal, first and second longitudinals, and the pœbrachial transverse veinlet black, the rest white; the pœbrachial areolet closed before the fork of the pœbrachial vein. Legs stout and pubescent, reddish-brown, tarsi black, *fourth tarsal joint about twice as long as the fifth*. Length, 3 lin.

D. Chiron., Hal.

Male: "Antennæ brownish-yellow; first joint dusky cinereous; feathers yellowish; last joint much longer than the rest jointly. Thorax with the sides ferruginous before the wings (scutellum also, but darker). Wings hyaline, veins very pale; pœbrachial areolet closed a little beyond the fork of the pœbrachial vein. Halteres pale yellow. Legs and coxae ferruginous; only the tips of the tarsi dusky; *fourth joint of the tarsi about twice as long as the fifth*; posterior tibiae and femora hairy; fore tarsi still more so; first joint a little shorter than the tibia. (Abdomen lost in the only specimen.)"

Haliday MSS. Length, 2 lin.

D. Waltlii, Mg.

Female: "Blackish, with a slaty-gray tinge on the vertex, mesonotum and metanotum, and three faint, darker, shifting stripes on the mesonotum. Antennæ 7-jointed; last joint long elliptical, as long as the three preceding. Wings hyaline, with the anterior veins conspicuous, fuscous. The pœbrachial areolet closed beyond the fork of the pœbrachial vein. Incisures of the abdomen with a paler shade. Legs finely pubescent; first joint of the fore tarsi shorter than the tibiae; fourth shorter than the fifth, notched at the tip."

Ibid. Length, 2 to $2\frac{1}{3}$ lin.

D. Ammon., Hal.

"Pale slaty-gray. Fore-legs dusky; femora at the base and coxae light ferruginous; posterior femora and posterior tibiae ferruginous, except at the tips; tarsi somewhat lighter brown at the base, fourth joint the shortest, notched almost obcordate. ♂, front broad. Eyes a little emarginate internally. Antennæ nearly as long as thorax, dingy yellow; feathers light yellowish. Wings white, as is also the very faint pubescence on the hind margin; the usual veins

pale brownish—pale towards the base. Abdomen blackish, clothed with long, soft, pale hairs ; first joint of fore tarsus about as long as the tibiæ. ♀, antennæ 7-jointed, dusky first joint, thick, ferruginous ; last longer than the three preceding together. Thorax ferruginous, with three confluent bands on the mesonotum ; scutellum rather pitchy-reddish ; mesonotum and mesosternum pale slaty-gray. Wings broader than in the ♂, veins more evident, dusky ferruginous. Abdomen above, dark gray, except the incisures or (in immature specimens) only an interrupted dusky line down the back ; first joint of fore tarsus shorter than the tibia." *Haliday MSS.* Length, 2 lin. Found by Haliday in Ireland.

D. Typhon, Hal.

Female : " Very like the preceding species ; the antennæ 7-jointed. Pale-yellowish. Vertex, three confluent stripes on the mesonotum, metanotum and mesosternum, cinereous (scutellum paler). Antennæ fuscous ; first joint ferruginous ; seventh elliptical, as long as the three preceding or more. Wings white hyaline ; usual veins fuscous, yellowish towards the base ; pobrachial areolet closed beyond the fork of the pobrachial vein. Abdomen above cinereous, with pale incisures ; coxæ ferruginous, outwardly cinereous. Fore-legs dusky ; femora at the base and coxæ pale-yellowish ; posterior femora and tibiæ ferruginous, with dusky tips ; fourth joint of the tarsi short, obcordate, notched at the tip ; first joint of the fore tarsi very little shorter than the tibia." *Ibid.* Length, 2 lin. Found by Haliday in Ireland.

D. tonsus, Hal.

The smallest of this genus, the length being from 1 to 1½ lin. It resembles *D. ammon.*, but the antennæ are different, and the wings are not white. Antennæ dingy yellow, half the length of thorax ; last joint elongate elliptical, not one-fourth of the length of the antennæ ; second and next joints sub-globose, then gradually increasing in length, and becoming oblong, scantily verticillate, with very long hairs, not forming a plume as usual. Pobrachial areolet scarcely passing the fork of the pobrachial vein. Abdomen dusky, with pale band on each segment ; slightly hairy. Legs longer than in *ammon*. Found (by Haliday) in Ireland, and one near London.

D. notata (Staeg.) is also said to be British.

GENUS.—*Tanyptus*, Mg.

This genus is better known than any of the preceding, except *Chironomus*. The *Tanypti* are very similar to the *Chironomi* in their

habits, many of them appearing in large clouds ; they are all extremely delicate creatures, some being quite transparent (*T. monilis*). The majority have spotted wings. They are mostly very small flies, the largest (*T. nebulosus*), sometimes reaching 4 in. The larvæ are generally found in damp and swampy places, wherever stagnant water abounds (*T. monilis*, *maculatus*, etc.). I have also taken them (*T. varius*, *culiciformis*) from running water (in the Cam, which seems to be remarkable for the number of Chironomid and Culicid larvæ present). The two best known are the larvæ of *T. maculatus* and *monilis*, which are here described. *T. maculatus* : The larva of this species, according to De Geer, resembles that of the gnat *Corethra plumicornis*, figured by Réaumur and many others since, but is less elongated, head more oval, and the thorax having at its base a long pediform bifid tentacle (prolegs), and the tip of the abdomen furnished with four minute triangular plates (evidently analogous to the four branchial appendages of *C. plumosus*), which have two long pediform appendages beneath and two above, the latter more slender and with long terminal hairs. It has ten claw-like legs, four anterior ones pointing towards the head, and are distant from each other, upon the fourth and fifth segments of the body ; and six posterior ones, which point towards the anus, very close together, placed upon the eighth, ninth and tenth segments. In the thorax may be noticed a pair of oval, opaque bodies, which are supposed to be air-reservoirs ; these, when the larva assumes the pupal stage, appear to become external and placed on the back, and resemble the respiratory horns of other aquatic pupæ. The pupa is like that of *Culex*, but with broader, oval, thoracic appendages, and small anal plates. *T. monilis* : The larvæ of this species are found in swampy places, wherever stagnant water is found. They are very small creatures, no thicker than a hair, and nearly a quarter of an inch long. There are two feet in front, armed with a circlet of movable claws ; these feet are retractile. The posterior pair of legs are placed at the anal end of the body, somewhat larger than the fore-legs ; they are not retractile, however. They swim with a curious serpent-like motion, and may also be seen crawling upon the aquatic weeds.

Characters of the Genus Tanypus.

Body elongated and pubescent. Eyes separate in both sexes. Palpi 4-jointed, curved ; first joint shorter than the second, second shorter than the third, fourth nearly as long as the second and third. Antennæ 14-jointed, filiform, seated in a notch in the eyes ; plumose

in the ♂, joints one to twelve, very small, thirteenth very long, fourteenth short and conical; in the ♀ the antennæ are pilose, the fourteenth thicker than the others, pubescent and more acuminate. Thorax elevated; scutellum rather small; metathorax with a longitudinal furrow. Abdomen composed of eight segments, long, hairy; more hairy and longer in the ♂ than in the ♀. Wings often pubescent; hairy along the hind border, mediastinal ending at beyond half the length of the wing; subcostal ending at before two-thirds of the length; radial emerging from the præbrachial transverse veinlet, ending at beyond three-fourths of the length; cubital also proceeding from the præbrachial transverse veinlet, ending at very little in front of the tip, subapical ending at very little behind the tip; subanal forming a fork of the præbrachial; anal complete; subaxillary not reaching the border. Posterior margin much excavated. Legs long and slender, pubescent, unarmed; coxae of moderate size, unguis very small; in the ♂ the fore tarsi are often pilose, bare always in the ♀. Plate iv., fig. 6.

There are as many as nineteen species recorded from Great Britain, but five of these seem of somewhat doubtful occurrence, and there are four reputed species.

They may be divided into two groups, (A) those with spotted wings, and (AA) those with unspotted wings:

A. WINGS SPOTTED.

(a). Thorax with four dark stripes.

i. Testaceous; ferruginous stripes.

Wings gray, with pale spots and with a pale band in the middle. Legs slender, hairy, tips of the joints dark brown. Length, 2 to 2½ lin. Common.

Varius, F.

ii. Silver-gray. Wings with a gray spot near the fore border at three-fourths of length and with gray streaks on the veins along the hind border. Costal veins black. Legs pale testaceous. Length, 3 to 4 lin. Common.

Nebulosus, Mg.

iii. Hoary. Wings clouded with gray, nearly limpid along the costa towards the base and at the tips; discal transverse veinlet clouded with black. Abdomen brown, posterior borders of segments nearly white. Length, 1½ to 2 lin. Common.

Choreus, Mg.

=fasciatus, Mg.,
sylvaticus, Mg.

(aa). Thorax with three dark stripes.

iv. Very pale reddish-brown. Thorax with three dark gray stripes, middle one divided, scutellum white, metathorax gray. Wings slightly milky white, with three irregular and faint pale brown bands; transverse veinlet clouded with darker brown. Abdomen whitish, hairy, a pale brown band on each segment. Legs white, long, slender. Length, 3 lin.

Punctatus, F.

v. Gray. Thorax almost white; three brown stripes. Wings whitish, with several gray dots and with a dark brown mark near middle of costa. Legs white, with black tips to the joints. Length, 3 lin. Common.

Punctipennis, Mg.
= *cinctus*, Panz.

vi. Three ferruginous stripes on the thorax. Body of ♂ grayish, with brown sutures to segments; ♀ reddish-brown. Wings with three irregular gray bands, one apical, the third a little before middle of wing, middle one very slender and pale. Length, 1½ to 2 lin.

Carneus, F.
= *albipes*, Fries., Mg.

vii. Pale testaceous. Thorax with three red stripes. Three indistinct pale brown bands on the wings. Abdomen in ♂ whitish and hairy, with dark brown band on each segment; in the ♀ it is pale reddish-brown. Length, 2 to 3 lin. Not rare (Walker).

Zonatus, F.

viii. Testaceous. Thorax three brown stripes; metathorax gray. Four brown discal spots on wings, two in front, two behind, tips faintly striped with gray. Length, 1½ to 2 lin. Rare.

Laetus, Mg.

ix. ♀ brown. Thorax white, three brown stripes. Gray spot on hind border of wings at one-fourth of length and gray band a little beyond middle, nearly absent in the disc. Length, $\frac{3}{4}$ lin. Rare.

Culiciformis, F.

(aaa). Thorax indistinctly striped.

x. Grayish-brown. Wings whitish with gray spots and with black dots in front. Three black bands on the tibiae, one in middle of metatarsus. Abdomen whitish in ♂ with brown band on each segment. Length, 2 to 3 lin. Common. } *Monilis*, L.
= *maculatus*, Deg.

AA. WINGS NOT SPOTTED.

(a). Thorax striped.

aa. Thorax with three brown stripes.

xi. Deep black and stout. Thorax with hoary tinge and three brown stripes. Transverse veinlet clouded with black. Legs testaceous, pubescent, long, slender. Length, $2\frac{1}{4}$ lin. (?) } *Plumipes*, Fries.

xii. ♂ hoary. Palpi and antennae black, plumes brown. Discal transverse veinlet clouded with black. Abdomen whitish, pubescent, with a blackish band on the fore border of each segment. Legs testaceous. Length, $2\frac{1}{2}$ lin. "Rare. In British Museum" (Walker) (?). } *Notatus*, Mg.

aa. Thorax with three reddish or luteous stripes.

xiii. Testaceous. Three reddish stripes on thorax. Wings limpid white, veins pale testaceous along the costa. Length, $1\frac{1}{2}$ to $2\frac{1}{2}$ lin. } *Melanops*, Wied.
= *bicolor*, Fries.

xiv. Testaceous. Three reddish stripes on thorax. Wings grayish, hairy. Abdomen hairy. Length, $1\frac{1}{4}$ lin. (?) } *Ferrugineicollis*, Mg.
= *tanyptodipennis*, Fries.

xv. ♂ whitish. Three luteous stripes on thorax. Abdomen pubescent, sutures of the segments and tip brownish. Length, 3 lin. } *Melanurus*, Mg.

aaa. Thorax gray with black stripes.

xvi. Black. Very small. Length, $\frac{2}{3}$ lin. (?) } *Pusillus*, Mg. (?)

(aa). Thorax not striped.

xvii. ♀ black, shiny, stout. Legs stout, tawny; fore tibiæ and tips of tarsi, femora and remaining tibiæ brown. First, second, third veins and transverse veinlets brown. Length, 3 lin.

} *Nervosus*, Mg.

Pygmaeus, V. d. Wulp, is also found in England.

GENUS.—*Clunio*, Hal.*

This is a small genus, containing, as far as we know, only two European species :

The proboscis and palpi are obsolete; the thorax large and the abdomen small, with large hypopygium, about the same size or even larger than the abdomen. Antennæ are 11-jointed, the third and eleventh joints being elongated, the intervening joints being small. The head is round and the thorax passes over it like a hood. Four veins only present in the wings, the second and third being forked; there are no transverse veinlets. (Pl. iv., fig. 7.)

C. Marinus, Hal.

As I have not seen this myself, I append Haliday's description of it, the male only apparently being known :

“ Dusky ferruginous. Head rounded, inflected to the præsternum. Mouth obsolete. Eyes rounded; distant above, approximate beneath, the antennæ. Antennæ, legs, wings, and halteres dingy white. Antennæ 11-jointed, shorter than the thorax; the short joints rather dusky; the basal joints sub-globose; the terminal ovate, the third and last elongate, elliptical. Thorax projecting over the head; scutellum and sides of the thorax before the wings pale yellowish; mesonotum divided by two parallel sutures, with an elevated line down the middle, and a depression before the convex, semicircular scutellum; metathorax very short; mesosternum gibbous. Wings adiaphanous, naked, except the pubescent margin; præbrachial vein (second longitudinal vein) bifurcated about its middle, embracing the apex with its branches; pobrachial (third) forked near the margin with the hinder branch (sub-anal) recurved, ending at the posterior margin; radial-cubital (first longitudinal vein) fainter between the præbrachial and the costa, ending at about the middle of the latter; anal vein (fourth) simple. Abdomen dusky,

* *Nat. Hist. Review*, ii. Proc., 62, pl. 2, fig. 4, 1855, Haliday.

with nacreous gloss, shorter than the thorax, dilated backwards ; segments linear-transverse. Hypopygium as long as the abdomen, and thicker ; lateral arms massive, oblong, with a smaller malleoliform piece articulated to the end ; below them an oblong plate,

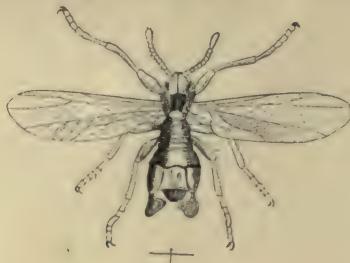


FIG. 40.—*Clunio marinus*.

rounded at the tip. Legs of moderate length, fore pair distorted at the base ; coxae ferruginous ; extreme base of tibiae blackish ; tarsi shorter than the tibiae ; anterior pair with the first joint long, the following three very short ; hind pair with the third joint also elongated.

“Inhabits the sea coast, amongst the moist gravel bared by the ebbing tide ; walks about with wings raised and half-expanded, in constant vibration, but without taking flight, as far as observed.”

This curious insect appears in July, and was taken by Haliday in Ireland. The other European species is *C. adriaticus*, Frauenfeld. Concerning this species, Frauenfeld says : “Bie Triest in submarinen Colonien von *Mytilus*.”

GENUS.—*Ceratopogon*, Mg.

This genus seems to be at present in a very chaotic condition, although they do not seem nearly so difficult to understand as most of the other Chironomidæ. The classification formed by Winnertz is the best we can get, and so it is followed in the present work. The flies of this genus are, in common with the other chironomids, called “midges.” They appear in great swarms, and the females are very troublesome, most of them being blood-suckers, and showing a decided preference to mankind. The males do not seem to be sanguinary in nature. There are some, also, which are carnivorous in nature, living upon smaller insects, which they kill by means of their sharp proboscis. The larvæ of this genus live both in water and on land, some (as *lateralis*) inhabit manures, others are found under the bark of decaying trees (*bipunctatus*). The transformation of the latter species has been frequently observed.

Larva of Ceratopogon.—The larvae, which are terrestrial, dwell beneath the bark of decaying trees amongst their own “frass,” and in manure. They are cylindrical white grubs with the anterior part somewhat enlarged; the head is small and retractile. The



FIG. 41.—Larva of *C. bipunctatus*.

segments are deeply constricted, and are armed with two dorsal setæ (*bipunctatus*); others (*lateralis*) have no setæ, and are furnished with pediform appendages on the prothorax and anal segment.

The pupæ are much shorter than the larvæ, and are broadest in



FIG. 42.—Pupa of *C. bipunctatus*.

front, with two short lateral appendages; the rudiments of the wings and legs are plainly marked; the abdomen, which tapers to a point, is armed on each side with bristles. The pupæ of *lateralis* are provided with eight long filiform appendages on the back of the thorax.

Characters of the Genus.

Body small, pilose or bare. Head depressed in front, produced into a short rostrum. Eyes lunate. Proboscis with fleshy labium; labrum horny, seated on upper base of labium. Maxillæ long and horny. Antennæ thirteen jointed, seated on a thick base; first eight joints oval, the remainder elliptical, hairy; subcostal vein ending much beyond half the length of wing; radial ending near tip; cubital ending by the tip; subapical simple, sub-anal forked; anal not reaching the border. Abdomen composed of eight segments. Legs almost equal in length; femora armed beneath with spines. Pl. iv., fig. 8.

The genus *Ceratopogon* tabulates as follows :

A. Antennæ with the five last joints elongated.

A. Wings with two cubital areolets, or with one, distant from the præbrachial.

α Wings wholly or partly hairy, quite bare in the ♂'s of some species. Femora simple, unarmed.

β Ungues with hairy onychia; equal length in ♂ and ♀.

γ First tarsal joint shorter than, or of equal length to, second.

δ Subcostal united to costal in middle of fore border or before it. 1.

$\delta\delta$ Subcostal united to costal between middle of fore-border and tip of wing.

2. Piceous; sides of pectus shining; wings with black down; base and a triangular costal tuft whitish.
3. Black; thorax shiny. Gray pubescence on wings; tibiæ fringed with pointed lancet-like scales.
- $\gamma\gamma$ First tarsal joint longer than second.
- δ Subcostal united to costal in middle of fore-border or before it.
4. Black; thorax with short yellow and long black hairs.
5. Black, shiny; thorax with black hairs. (♀)
6. Deep black; thorax with black hairs, gray in some lights.
7. Mouse-coloured, dull; thorax with tawny hairs, yellow and black.
- $\delta\delta$ Subcostal united to costal between middle of fore-border and tip of wing.
8. Black, shiny; thorax clothed with long yellowish-white hairs.
9. Black, not shiny; thorax clothed with long black hairs; legs hairy; tarsi white.
10. Black, not shiny; thorax clothed with long black hairs; legs piceous; tarsi yellow.
11. Black, shiny; thorax clothed with short whitish down; legs pale piceous; long pale hairs.
12. Black, shiny; thorax clothed with gray hairs. Legs yellowish.
13. Grayish-brown; thorax clothed with yellowish hairs. Scutellum fringed with few black hairs.
14. Blackish-brown; thorax clothed with yellowish hairs. Scutellum fringed with few black hairs. Halteres brownish; white knobs.
15. Black; thorax shiny, yellow hairs. Legs ferruginous. Halteres yellow.
16. Blackish-brown; thorax shiny, yellow hairs. Legs yellowish-white. Halteres milk-white.
- $\beta\beta$ Ungues with bristly hairs instead of onychia. Of equal length in ♂ and ♀.
- γ First tarsal joint longer than second.
- δ Subcostal united to costal between middle of fore-border and tip of wing.
17. Piceous. White down on thorax. Palpi brown. Legs pale yellow.

Bipunctatus, L.

Piceus, Wtz.

Ciliatus, Wtz.

Crassipes, Wtz.
Brevipennis, Macq.

Alacer, Wtz.

Murinus, Wtz.

Titillans, Wtz.

Halteratus, Wtz.

Velox, Wtz.

Frutetorum, Wtz.

Lucorum, Mg.

Rostratus, Wtz.

Brunnipes, Mg.

Fuscus, Mg.

Minutus, Mg.

Amanus, Wtz.

18. Brown. Black hairs on thorax. Palpi yellow. Legs pale yellow; black punctures at tips of knees and tibiæ.

19. Yellowish-cinereous. Scutellum yellow. Palpi brownish - yellow. Legs pale yellow; black punctures at tips of knees and tibiæ.

20. Cinereous. Blackish-yellow hairs, with broad brown stripe and band, and few spines at base of wings. Legs as in 19.

21. Yellowish-cinereous. Scutellum yellow. Palpi yellowish-brown.

22. Gray. Dark brown stripe on each side in front of wing on thorax. Palpi brown.

23. Gray; white hairs. Thorax black. Legs pale yellowish, tips black. Palpi yellow.

24. Blackish-gray. Thorax with five stripes; scutellum tawny. Legs piceous; tarsi pale. Palpi black.

25. Black. Thorax brown; dingy yellow spot on each side of pectus and one on each shoulder. Legs brownish; tarsi pale.

26. Blackish-gray. Thorax with few black hairs. Palpi yellow. Legs pale; knees dark.

27. Blackish-brown. Thorax with few black hairs. Palpi black. Legs pale piceous.

$\beta\beta\beta$ Ungues without bristly hairs or onychia. One of the unguis longer than the other. First tarsal joint longer than second. Subcostal united to cubital between middle of costa and tip of wing. 28.

$\alpha\alpha$ Wings quite bare. Subcostal united to costal between middle of fore-border and tip of wing.

β Femora unarmed.

γ Ungues not denticulate.

δ Ungues of δ and φ of equal length. 29.

$\delta\delta$ Ungues of equal length, with short claw by them in φ . 30.

$\delta\delta\delta$ Claw in φ longer than others.

31. Yellowish. Head with some white marks in form of a cross behind crown. Palpi yellowish. Thorax whitish-yellow, with purplish-brown stripes and points. Legs dark brown.

32. Yellowish; occiput and vertex fuscous. Palpi fuscous. Thorax glossy black; scutellum yellow. Legs pale yellow and blackish joints.

$\beta\beta$ Some or all the femora spinose on the under side.

γ Ungues without spines.

δ Ungues equal in δ and φ . Planteæ hairy.

33. Black and shiny. Femora with eight spines.

34. Blackish-brown. Fore femora seven, mid femora one, hind femora three spines.

35. Blackish-brown. Fore femora six to ten spines; halteres yellowish, black tip.

36. Yellow. Fore femora six to ten spines; halteres cream-white.

Varius, Wtz.

Fascipennis, Staeg *

Pictipennis, Staeg.

Arcuatus, Wtz. †

Pulicaris, L.

Albicans, W.

Aestivus, Wtz.

Scutellatus, Mg.

Pumilus, Wtz.

Neglectus, Wtz.

Ochraceus, Wtz.

Lacteipennis, Zett.

Nitidus, Macq.

Illustris, Wtz.

Gracilis, Hal.

Flavipes, Mg.

Spinipes, Mg.

Brachialis, Hal.

Distinctus, Hal.

* Wings grayish, with two short white bands in front; first about middle, extending from costa to full half the breadth; second nearer tip; white streak along hind-border near base.

† Wings gray, pubescent, marked with some large limpid spots and some small brown spots.

δδ One of the unguis longer than other in ♀.
Plantæ hairy. 37.

γγ Ungues with some spines on the inner side, of equal length.

δ Plantæ hairy.

38. Black, shiny. Anterior femora four spines, hind three.

39. Black, shiny. Anterior femora many spines, hind three.

40. Gray, blackish hairs. Anterior femora seventeen spines, hind three.

δδ Plantæ spinose.

41. Black, shiny. Anterior femora ten spines, mid two, hind four.

42. Blackish-gray. Anterior femora twenty-one to thirty spines, mid seven to twelve, hind eight to sixteen.

βββ Hind femora incrassated, spinose beneath. No spines on unguis. One claw longer than others. 43.

AA. Wings with one cubital areolet, produced from the præbrachial to the costa. Wings bare. Subcostal united to costal between middle of fore-border and tip of wing.

α Femora simple. 44.

αα Some or all the femora spinose on the under side.

β Ungues without spines.

45. Palpi whitish. Halteres dark brown, white at base.

46. Palpi yellowish-brown. Halteres white, knobs dark.

ββ Ungues of ♀ with spine on inner side.

47. Halteres pale-yellowish. Fore femora with two spines at the middle. Tarsi dusky. Hind tibiae strongly ciliated.

48. Halteres dusky, ferruginous. Fore femora with two spines between middle and end. Tarsi pale yellowish. Hind tibiae not strongly ciliated.

αα Antennæ with the last three joints elongated. 49.

Fulvus, Macq.

Serripes, Mg.

Rufipectus, Wtz.

Lineatus, Mg.

Tibialis, Mg.

Fasciatus, Mg.

Femoratus, F.

Venustus, Mg.

Signatus, Mg.

Ornatus, Mg.

Tæniatus, Wlk.

Calceatus, Hal.

Pictus, Mg.

The following, described fully, are the most abundant British species :

$$C. bipunctatus, L = \begin{cases} C. trichopterus, Hoffm. \\ C. geniculatus, Guér. \\ C. hirtulus, Zett. \end{cases}$$

Piceous. Head brown. Antennæ brown; plumes paler towards the tips in the ♂. Thorax hairy; hairs pale yellowish-white; pectus pale in front, and with yellow streaks on each side, sometimes passing into almost a reddish tinge. Abdomen covered with gray hairs, and having white sutures in the ♂; ♂ genitalia reddish-brown.

Wings clothed with dusky hairs, and having a white dot beyond the middle of the costa; veins brown toward the costal region; paler in the ♂ than in the ♀. Legs with long pale hairs. Femora and tibiæ slightly thickened in the female. Length, 1 lin. Generally distributed and very abundant, especially in damp places and along rivers.

C. pulicaris, L. = *C. punctata*, Latr.

Gray. Head brown. Plumes of antennæ in ♂ yellowish, shiny in some lights; brown in the ♀; first eight joints oval, remainder elongate. Thorax with a dark stripe on each side in front of the wings. Pectus and scutellum brown. Abdomen dark brown sutures of the segments pale, nearly white. Wings white, with brown dots, the three along the costa being the largest, and much darker than the remainder. Legs pale brown; posterior tibiæ very pale; tarsi also very pale, dark at the joints. Length, about 1 lin. An abundant and widely-distributed species, often occurring in dense clouds in damp and marshy places, especially in the evenings in sultry weather.

C. nitidus, Macq.

Black and shiny. Head dark brown; plumes of the ♂ antennæ with bright white tips; in the ♀ the antennæ are often yellow towards the base; the first to eighth joints are oval, the ninth to thirteenth elongated; the first joint longer than the second and following. Thorax deep black. Abdomen with the two first segments transparent; in the ♀ the abdomen is much contracted at the base, where there are present a few white shiny hairs, as also on the tip of the abdomen and on the hind borders of the segments; on the ventral side is a large subapical tuft of long black hairs. Wings lanceolate; veins pale. Legs tawny, with black markings; first and second tarsal joints pale, with dark tips; third, fourth, and fifth black, the third pale at the base; unguis short and slender in the ♂, stout and long in the ♀; plantæ in ♂ with short, slender spines, in the ♀ with five or six pairs of stout spines. Length, 1½ to 2 lin. A common and generally distributed species.

C. lineatus, Mg.

Head gray; palpi brown, with first and second joints pale yellowish. Thorax pale dirty-white, with two stripes and two spots of a reddish-brown colour, the spots being placed behind the stripes. Scutellum brown; metathorax dark brown. Abdomen dark brown, with pale sutures. Antennæ in ♂ dark brown, the plumes pale yellowish-

brown; in the ♀ the antennæ are brown, with yellow base and yellow bands; first eight joints oval, next six elliptical and long. Wings slightly yellowish towards costa in the ♀. Legs tawny, dark at the tips of the femora, tibiæ, and tarsi; anterior femora armed with seventeen spines, middle with four, posterior with three; a thick bristle on side of hind plantæ. Length, 1 to 2 lin. Common and generally distributed; often in large clouds over stagnant water.

$$C. femoratus, F. = \begin{cases} C. morio, F. \\ C. ater, Mg. \\ C. rufitarsis, Mg. \\ C. armatus, Mg. \end{cases}$$

Shining black. Antennæ in ♂ with plumes glistening white towards their tips. Wings slightly milky, with brownish tinge; veins pale brown. Legs tawny; tarsi pale; joints, as usual, darker near their apex; hind femora thickly spinose beneath, slightly spinose above; long and incrassate; in the ♂ the claws are slender, and of equal length on all the tarsi; in the ♀ those of the anterior tarsi are equal; on the hind tarsi one claw is four times the length of the other. Length, 1 to 1½ lin. A common species, and met with in most places; subject to great variation, twelve distinct varieties being described by Winnertz.

Additional Notes on *Chironomus Larvæ*.

Some notes have been kindly placed at my disposal by Mr. Swainson, F.L.S., those concerning the supposed annelid *Comptonia cruciformis* (of Johnston), which is now shown to be a *Chironomus* larva, and which, from the figure sent, is evidently the same as the

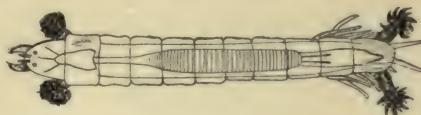


FIG. 43.—*Comptonia cruciformis*. Probably the larva of *T. Frauenfeldi*.

larvæ found by me in Guernsey (p. 171), being particularly interesting. I append the more important parts of Mr. Swainson's notes:

"In October last, on our Golf Links at St. Anne's-on-Sea, I found several larvæ of *Chironomus*, fully grown, in its splendid blood-red colour. These I kept during the winter, and watched their metamorphoses in small glass jars with the tops covered with muslin. They ultimately turned out to be *C. dorsalis*, and their resemblance to *Comptonia cruciformis* in all but colour is most remarkable. The haemoglobin which colours the 'harlequin' larva so beautifully is replaced in

the marine form by a light sea-green pigment. The mandibles and two pair of retractile hooked sucker feet are very similar to *C. dorsalis*, and I had, therefore, no doubt as to *Compontia cruciformis* of Johnston being a dipterous larva of the genus *Chironomus*. I found this larva several times on the *Obelia* zoophytes growing at the end of St. Anne's pier. Next I found it on some *Coryne* from the Mumbles (Swansea), and more recently I dredged it from fifteen fathoms off Spanish Head (Isle of Man) adhering to seaweed. Professor Miall, of Leeds, to whom I sent my specimens, thought it would ultimately turn out that Johnston's *Compontia* was Schiner's *Thalassomyia Frauenfeldi*. This seems very possible, as the description is very similar, but Schiner gives no drawings of the larva of this species in his 'Fauna Austriaca,' p. 596, vol. ii."

He continues to say, after mentioning Mr. Ridley's record* of this species at the Isle of Wight :

"I feel sure it is the same fly I have seen more than once on our pier-end at St. Anne's-on-Sea. I may add that Mr. Johnston's drawing of *Compontia* does not show the two pairs of long tubular protuberances which the larva can protrude from the tenth segment, though he mentions them in his description. These are shown, however, very clearly in the micro-photographs of my best mount of *Compontia*.

"In conclusion, I must not omit to tell you of what I feel sure is an instance of the very interesting development known as *Parthenogenesis* in connection with *C. dorsalis*. One of the larvæ, fully grown, was put in a bottle late in October, 1891. It sickened and died, but from the decaying body came forth a large number of young *C. dorsalis*, which ultimately became fully developed, though not so large as the other imagoes. The bottle containing them was in a cold room, and they all appeared in the winter before the end of February, and so could not possibly be hatched from eggs laid prior to October. I watched these most sedulously throughout the pupa state, for they spun their pupa-cells on the under side of leaves, and not in the mud at the bottom of the glass like the ordinary *Chironomus dorsalis*, waving their heads about in the curious way described by Meinert (21). They did not assume the deep blood-red colour either, being nearer the surface of the water. Finding that Oscar Grimm had recorded the fact that the pupæ of *Chironomus* laid the eggs prepared in the body of the larva, I watched the older non-parthenogenetic larvæ most carefully when they emerged from the larval state, and I must say nothing of this kind took place as far as I could see, and during the following month there were no young larvæ of *C. dorsalis* produced. It is possible that Professor Grimm's young larvæ were parthenogenetically reproduced." (G. Swainson, F.L.S., 1892.)

These notes are extremely interesting, not only on account of the fact that Johnston's *Compontia cruciformis* is shown to be the larva of a *Chironomus*, but also as showing what is an unusual character in Parthenogenesis. Parthenogenetic reproduction, as a rule, takes place in the summer months, as seen in the Aphides, Crustacea (*Daphnia*), and Cecidomyiæ, where we see the asexual reproduction taking place during the summer, and at the approach of cold weather the process of ovation taking its place. In regard to Oscar Grimm's observations, I have not had the opportunity of reading his original paper,† but the translation into English states that the pupæ produce ova parthenogenetically. This I had some doubts about, and on referring to Balfour's "Embryology"‡ I find it stated

* *Ent. Mag.*, 1884.

† "Ungeschlechtliche Fortpflanzung einer *Chironomus* Art. u. deren Entwicklung aus dem unbefruchteten Ei." Mem. Acad. Petersbourg, 1890.

‡ "Comparative Embryology," vol. i., p. 335. Balfour.

"that the *larvae* of *Chironomus* have been shown by Grimm to lay eggs which develop exactly in the same way as fertilized eggs into *larvae*." There may possibly be some misinterpretation in the English translation; if not, Mr. Swainson's and my own experience go against this "pupal-parthenogenetic reproduction."

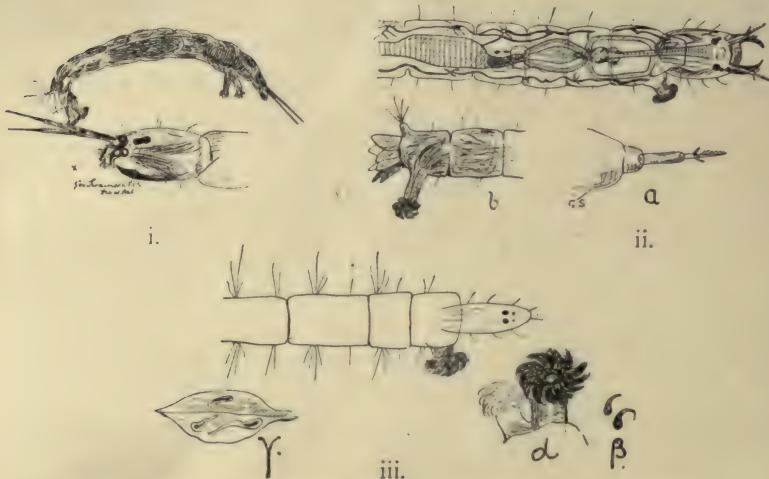


FIG. 44.—Three undescribed Larvae of *Chironomus* (sp.?). Swainson.

i. The above are three figures of undescribed larvae sent me by Mr. Swainson, and his notes are given below :

i. The two upper mandibles, one of which is shown at X, work on a kind of pivot, but both meet for tearing purposes on the hard chitinous lower jaw, thus making a triangle. They work, in fact, in planes at right-angles to each other, their line of intersection being the axis of the head or lower jaw.

ii. The above are some details of a new larva of *Chironomus* (sp.?) found in the ponds on the Golf Links, St. Anne's-on-Sea. a, the anal extremity; b, the antennæ.

iii. Another new form of *Chironomus* larva (sp.?) recently discovered by Mr. Hammond, F.L.S., mining tunnels in leaves of *Potamogeton* (γ). Body of larva 14 segments, including very protrusile and retractile head and anal segment very similar to one shown in fig. ii. The fore-feet are remarkable for the curious minute hooklets with which the skin below the larger hooks of the sucker foot are filled (α and β). They look very like the proboscis of the Gephyrean worm *Sipunculus*. The posterior sucker feet are not ornamented like the fore-feet, but are longer and more protrusile.

The segments have two sets of setæ, and one (the posterior) four to six in number. But most singular of all is the curious action of the mandibles and their position, far differing from those shown in my larva above (fig. i.), which meet on the horny-toothed plate below the mouth. These mandibles work in an upright way, seeming to retract for the straight down stroke. As Mr. Hammond says, "they work in longitudinal, vertical, and parallel planes, like the hooklets of the maggot of the Blow-fly." The head is much narrowed, to allow of some freedom of movement in the close quarters in which it resides. (Swainson.)

Literature on the Chironomideæ.

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2. Illiger's Magaz., ii. 261 (*Ceratopogon*). Meigen.
3. Dip. Scand., ix. (*Ceratopogon*). Zetterstedt.
4. Neue dipteral. Beitr., iv. 23. Loew.
5. Ent. Mag., i. 152, 154, and ii. 148, 1833 (*C. gracilis*). Haliday.
6. Ins. Brit., 3, 238 (*C. tenuiatus*). Walker.
7. Kröj. Tidskr., iii. 592, 2. Staeger.
8. Nat. Hist. Review, ii., proc. 62, 2 (*Clunio*). Haliday.
9. Verhandl. d. zool. bot. Verens., vi. 216, 1856 (*Clunio*). Schiner.
10. Verh. d. z. b. Verens., vi. 216 (*Thalassomyia*). Schiner.
11. Ent. Mo. Mag., 1884 (*Thalassomyia Frauenfeldi*). Ridley.
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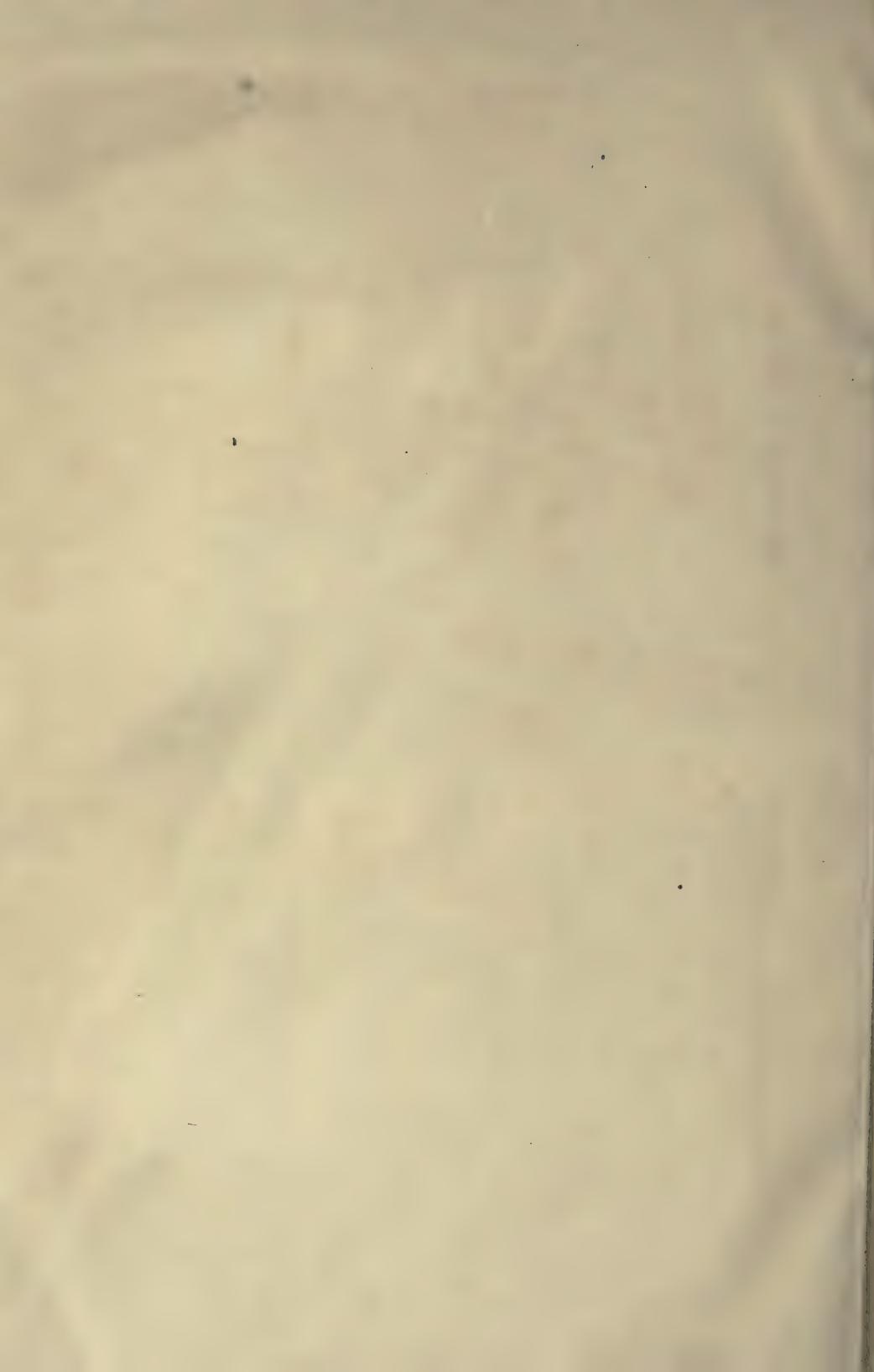
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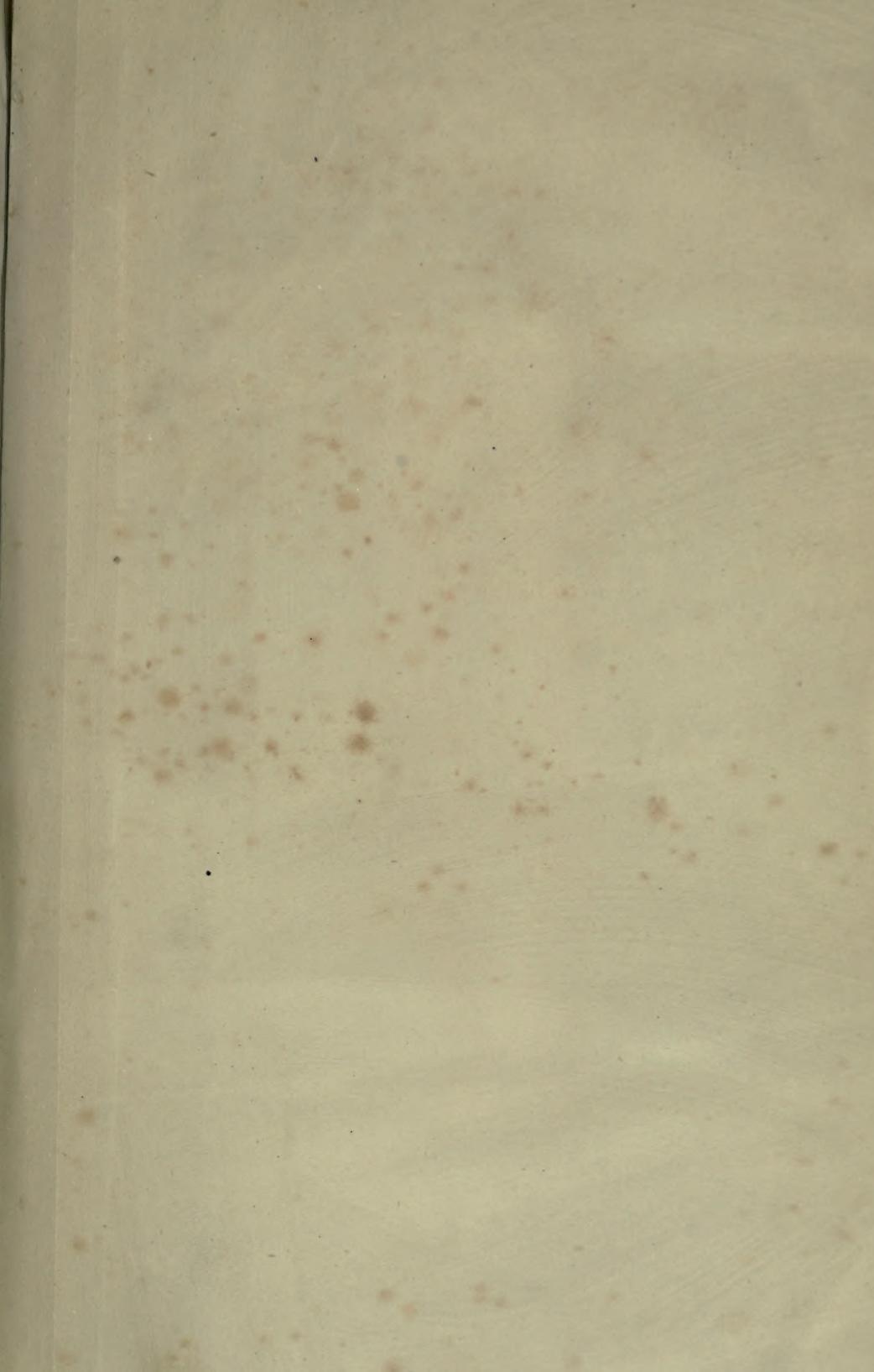
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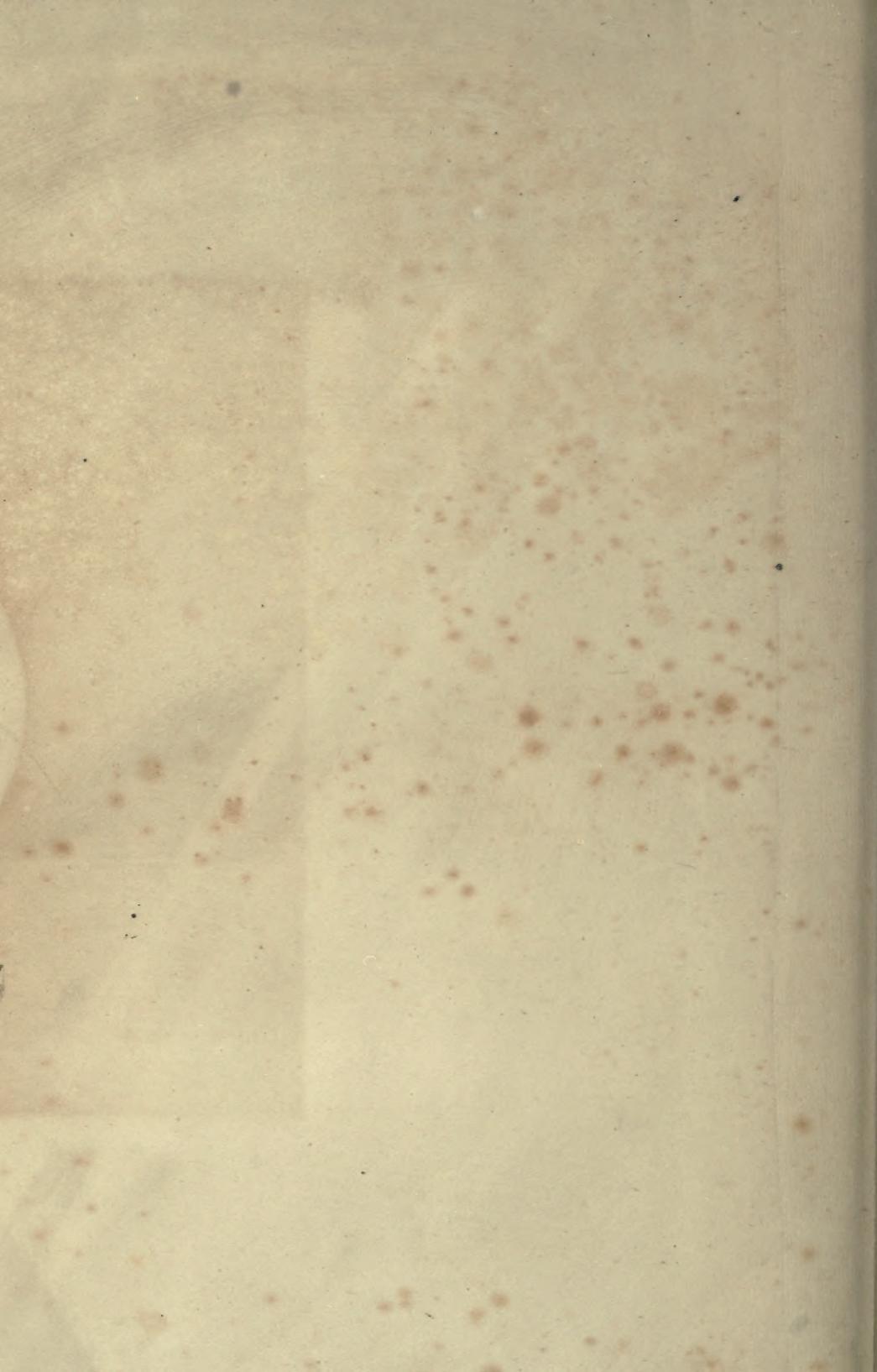
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